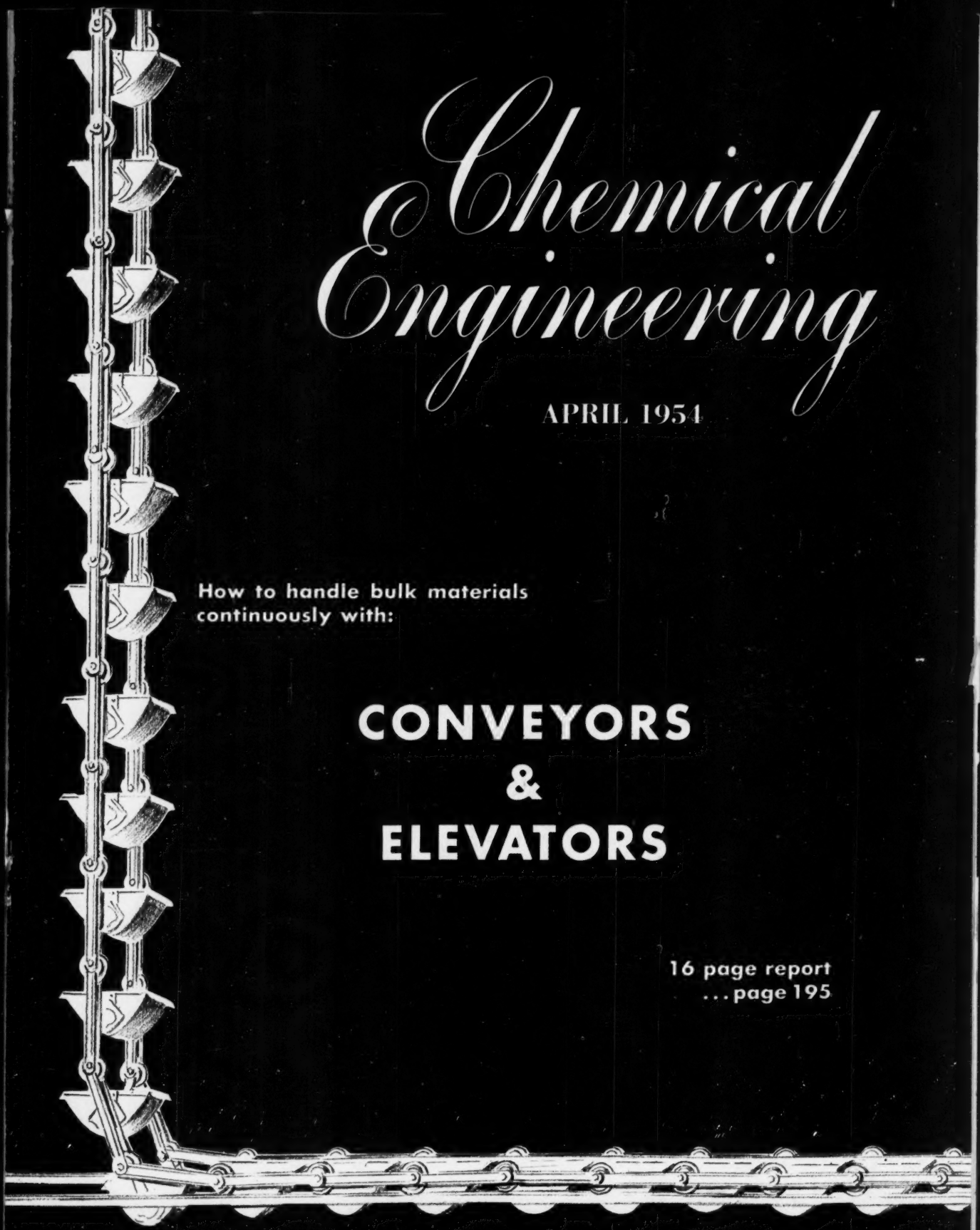


Chemical Engineering

APRIL 1954

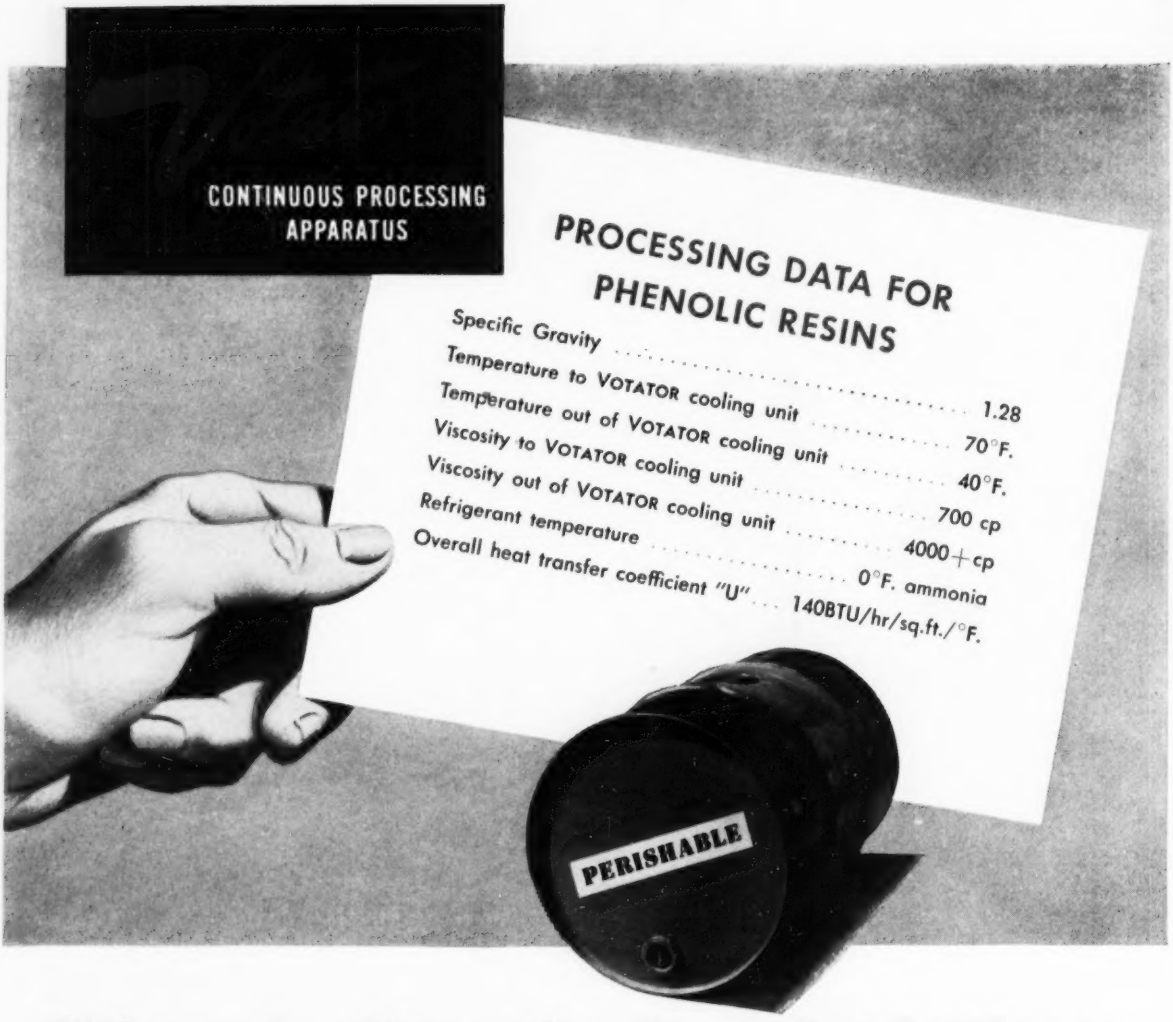
How to handle bulk materials continuously with:

CONVEYORS & ELEVATORS

16 page report
... page 195

A McGRAW-HILL PUBLICATION

ONE DOLLAR


CONTINUOUS PROCESSING APPARATUS
PROCESSING DATA FOR PHENOLIC RESINS
Specific Gravity 1.28
Temperature to VOTATOR cooling unit ..... 70°F.
Temperature out of VOTATOR cooling unit ..... 40°F.
Viscosity to VOTATOR cooling unit ..... 700 cp
Viscosity out of VOTATOR cooling unit ..... 4000+ cp
Refrigerant temperature ..... 0°F. ammonia
Overall heat transfer coefficient "U" .... 140BTU/hr/sq.ft./°F.
PERISHABLE

High speed cooling makes the product last longer

IF THE LIFE of your product is affected by temperature, perhaps you can benefit from these developments in phenolic resins:

At ordinary temperatures the polymerization reaction of these materials continues at a rapid rate and they become too viscous for laminating or bonding use. They are even perishable under refrigerated conditions. This thickening can be greatly retarded, and the useful product life extended if the resins are rapidly cooled prior to filling into drums.

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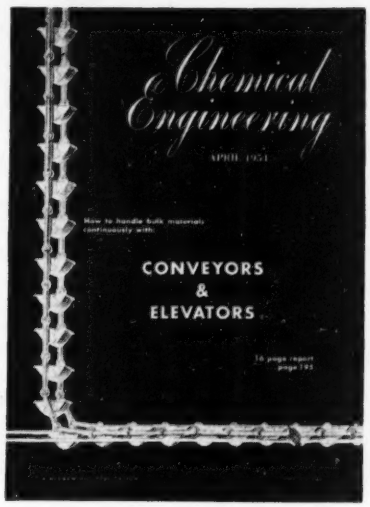
GUIDED TOUR

JOHN R. CALLAHAM, EDITOR



Coming: A Unit Op Special

Once a year CE brings out a big special issue on some unit operation or basic engineering subject.

Last year it was Heat Technology; in 1952 it was Process Instrumentation. This year it'll be Mixing.

This special report (it may run up to 64 pages) will be right down the practical man's alley. It's probably the first—certainly the most comprehensive—detailed review yet published for chemical engineers on the practical aspects of mixing as a unit operation.

It'll cover mixing of liquids, semi-solids and pastes and dry solids—both batch and continuous operations.

Although it covers basic theory, the report hits hardest at industry practice and equipment selection. You'll find a wealth of down-to-earth data in it. The author, now a consultant, summarizes his 16 years of broad industrial experience in the field of process mixing.

You'll find this "Mixing Special" in our June issue.—JRC.

. . . . . Most of today's processes hinge on moving bulk materials continuously.

That's why engineers throughout the process industries have been asking us for a practical, meaty roundup on bulk materials handling.

Expert Harry Strube now comes forth to fill the bill: An interpretive study that (1) points out the factors involved in moving bulk materials; (2) highlights basic features of all common types of equipment; (3) tells how to pick the proper equipment for a given job. *(Report)*

From idea to plant: DuPont's way.

Ray Genereaux gives a timely account of how DuPont's engineering department is organized, how it functions in practice. It's well worth a close look throughout the process industries. *(Article)*

Why use thick protective coatings?

There're two solid reasons why coatings above 5 mils thick can save you money. Pennsalt's R. R. Pierce, a seasoned hand

Please turn page

GUIDED TOUR

at fighting corrosion, brings a wealth of new data you can put to dollar-saving use in most any chemical operation. *(Article)*

Put dimensional analysis to work!

Most engineers would if they had a step-to-step outline of how to go about it. Here, at last, is the how-to that'll enable you to use this basic engineering tool. *(Article)*

Make the most of capital ratios.

Here's an analysis of sales-to-investment ratios for 100 processing firms. You can study it to see how your operation—or proposed new plant—stacks up against going operations in the same field. *(Article)*

Why use pneumatic conveyors?

They're versatile, safe, convenient, dustless. Often low enough in capital cost to offset their higher power needs. And sometimes they'll handle a job no mechanical conveyor can touch. *(Article)*

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Chemical Engineering

APRIL 1954

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CHEMICAL ENGINEERING
April 1954 Vol. 61—No. 4

Chemical Engineering (with Chemical & Metallurgical Engineering) is published monthly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office: 99-129 North Broadway, Albany 1, N. Y.

▶ **Executive, Editorial and Advertising:** 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Nelson Bond, Vice President and Director of Advertising; J. E. Blackburn, Jr., Vice President and Director of Circulation.

▶ **News Bureaus:** Chicago, Houston, San Francisco, Washington, Cleveland, Atlanta, Detroit, London, Paris, Frankfurt, Rio de Janiero, Mexico City, Tokyo, Manila. Correspondents in 44 capitals and principal cities.

▶ **Subscriptions:** Write to Chemical Engineering—Subscription Service, 99-129 North Broadway, Albany 1, N. Y., or 330 West 42nd St., New York 36, N. Y. Allow one month for change of address. Please show position and company connection on all subscription orders.

Single copies $1. U. S. and possessions, $3 per year, $4 for two years, $5 for three years; Canada, $4 per year, $6 for two years, $8 for three years; other Western Hemisphere, $15 per year, $25 for two years, $30 for three years; all other countries, single copies $2 each, $20 per year, $30 for two years, $40 for three years.

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OPENS WIDE THE POLYVINYL DOOR!

Beyond the door – a wonderland world of polyvinyl plastics. A gay, bright array of breathtaking products ... amazing in their origin, brilliant with the modern touch of usefulness.

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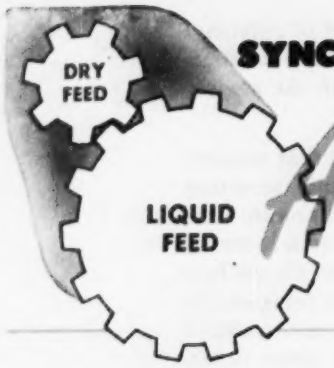

SYNCHRONIZED

Automatic System

FOR CONTINUOUS PREPARATION OF FILTER AID SLURRY

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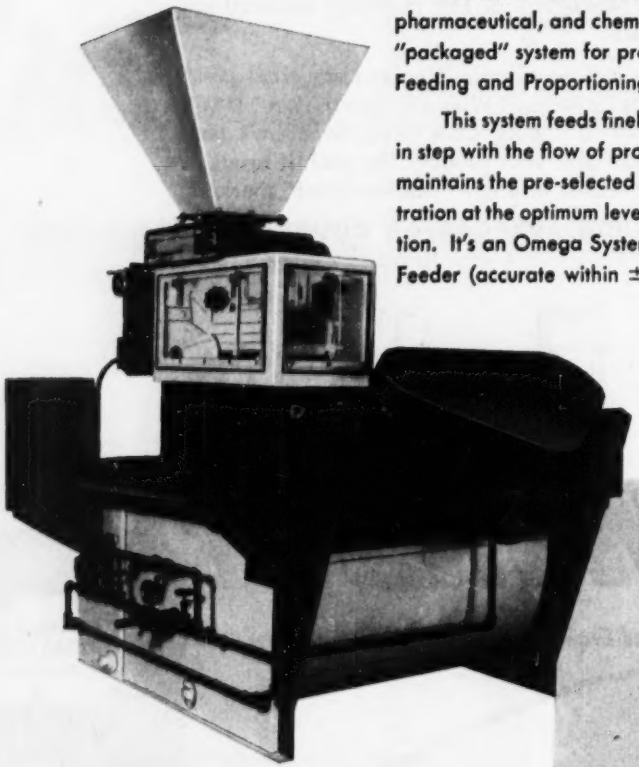
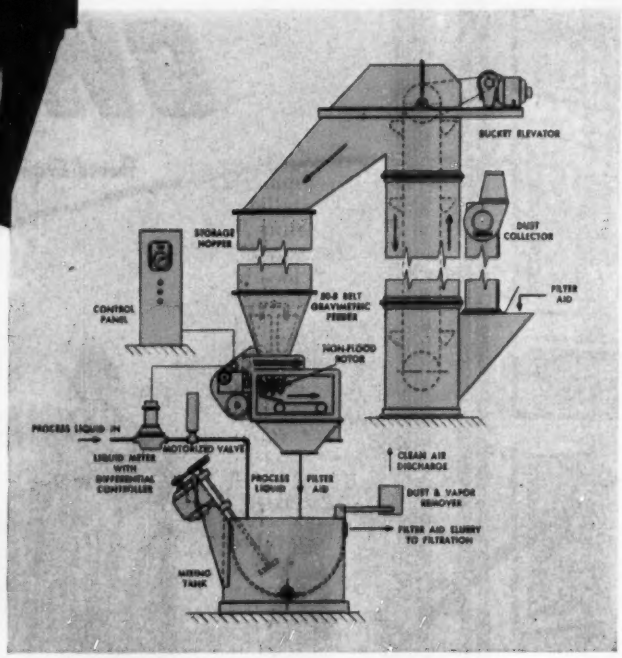
This system feeds finely pulverized filter aid (weighing 7 to 15 lbs. per cu. ft.) in step with the flow of process liquid to the filters. A sensitive synchronizing unit maintains the pre-selected ratio of dry material to liquid . . . keeps slurry concentration at the optimum level . . . eliminates hit-or-miss, high-cost manual preparation. It's an Omega System throughout — from the Model 50-8 Belt Gravimetric Feeder (accurate within ± 1% by weight) to the mixing tank, dust and vapor removal devices, synchronizing mechanism, and control panel. The design and construction of this "packaged" system is 100% an Omega responsibility which relieves the customer of the purchasing and engineering of individual components.



Omega Dry and Liquid Feeders fit into the widest range of continuous processing and blending operations. Tell us about your problems and we will gladly submit recommendations and quotations. Omega Machine Company (Division of B-I-F Industries, Inc.), 369D Harris Ave., Providence 1, Rhode Island.



Continuous slurry preparation system including Omega 50-8 Belt Gravimetric Feeder with positive, non-flood feeding mechanism; mixing tank and agitators; dust collector, bucket elevator, storage hopper; control panel and differential controller.

OMEGA *THE LAST WORD IN* **FEEDERS**

DIVISION OF B-I-F INDUSTRIES, INC.

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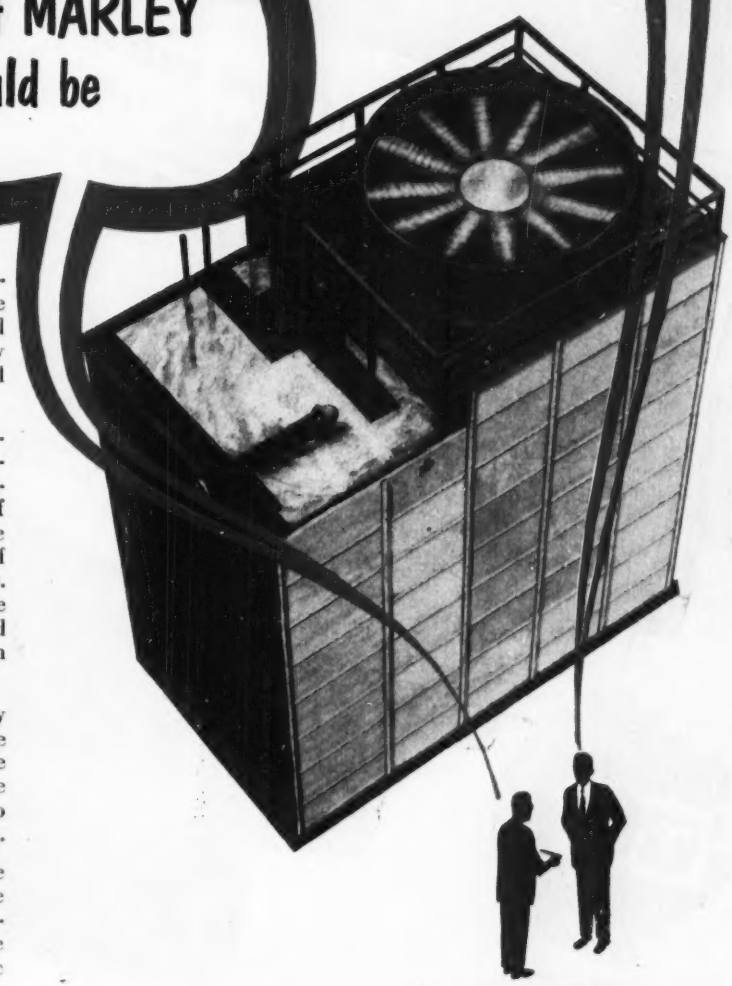
BIF METERS FEEDERS CONTROLS

What's the temperature of the basin water?

84°— just what MARLEY said it would be



Thermal control dictates the economy of every process operation, and the key to control is cold water — delivered consistently at design specification. Every Marley cooling tower offered today will produce that optimum result.

Built into every Marley tower is the pretested performance ability to do its specified job (or more) day-after-day, year-in-year-out. This is the result of 30 years of constant research and development; the result of 10,000 separate installations of Marley mechanical draft cooling towers. Today Marley has positive performance data for every tower for any location and Marley backs its knowledge with an equally positive guarantee.

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The Marley Company

Kansas City, Missouri

MARLEY

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THIS PLANT PRODUCES ONLY ONE KIND OF SOLUTION—

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Tests are not limited to a single type of separating method. Findings are therefore unbiased.

Use this plant not only to get the facts and figures on new filtering operations but to check the efficiency and economy of your present ones. Take full advantage of these unsurpassed filtration test facilities.

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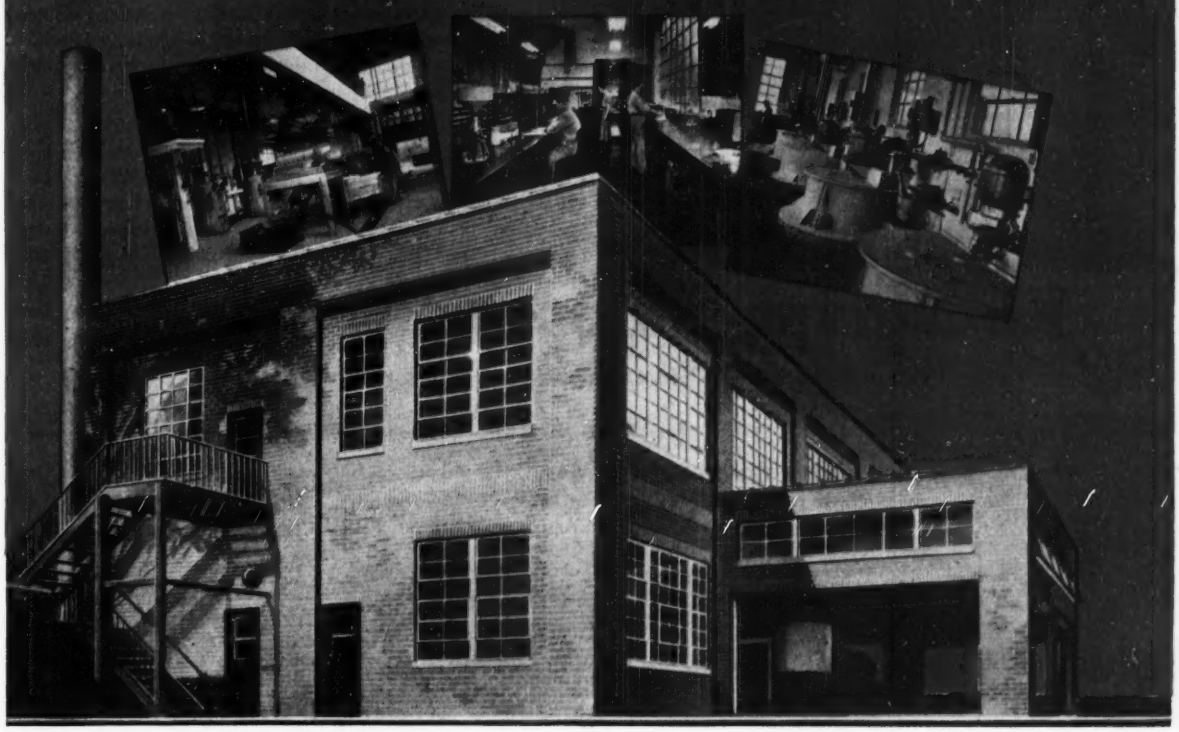
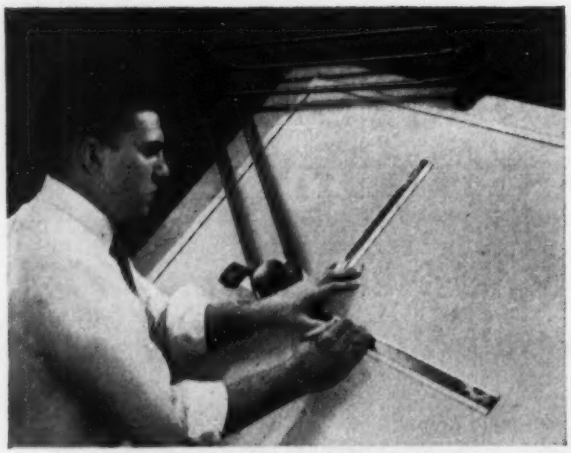
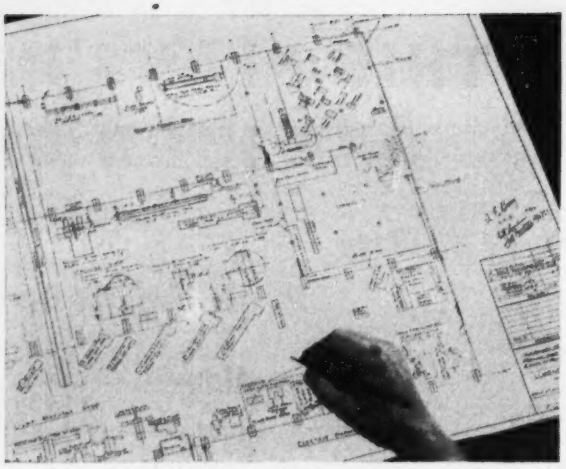




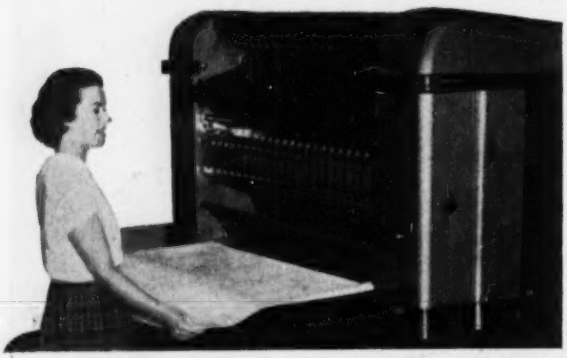
Instead of starting all over again



. . . he begins here

Here's how the Lukens Steel Company, Coatesville, Pa., uses Kodagraph Autopositive Paper to eliminate retracing in preparing flow diagrams and piping layouts.

THESE diagrams and layouts must also show the floor plans and fixed equipment installations of the departments involved. But instead of retracing this information from the basic plant layout drawings, Lukens Steel simply reproduces the drawings on Kodagraph Autopositive Paper—gets *positive, photographic* duplicate tracings directly. This gives the draftsman a tremendous head start . . . for he only has to add the new detail to the Autopositive print . . . *and another job is done instead of being barely begun.*



Low-cost Autopositive reproductions are made this easily at Lukens Steel:

Kodagraph Autopositive Paper is exposed with the drawings in a direct-process machine . . . and processed in standard photographic solutions. A fast, convenient room-light operation that produces positive photographic intermediates *without a negative step . . . without a darkroom.* These intermediates, in turn, assure highly legible prints.

Lukens Steel Company also uses Autopositive Paper *to produce print-making masters* from vendor blueprints; *to simplify filing,* by combining small vendor drawings on Autopositive intermediates in the standard Lukens drawing size; *to get low-cost protection* for original drawings which must be sent out of the plant.

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WHILE you're still in the planning stage, here's an exact method of determining the best process for your requirements. Send a sample of your material—a pound or a ton—to Link-Belt.

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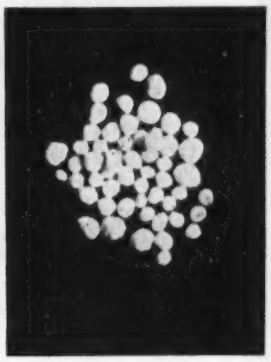
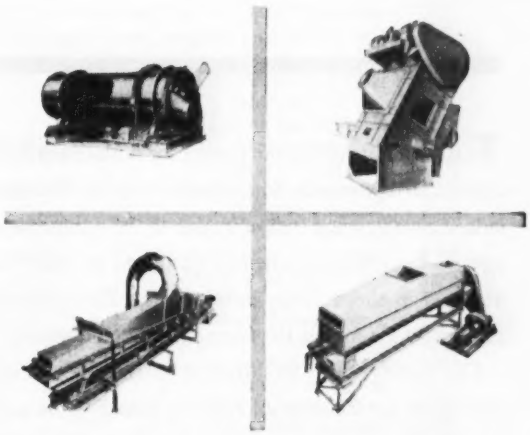
It's this complete development service that is in large part responsible for the more than 600 Link-Belt dryers now in service. They're operating profitably all over the world . . . successfully processing over 100 different materials.

Ask your Link-Belt representative about this no-obligation service today. He can also give you information and literature on Link-Belt's broad, quality line of processing and materials handling equipment.



From sludge to pellets . . .

Enlarged photographs show a sludge material before and after processing. Moisture content has been reduced from 10% to 1%, and the end product is easily handled with no dust. The Link-Belt laboratories can show you how you can economically change the size, shape or consistency of materials . . . blend, compound or convert them to desired chemical compositions.



LINK-BELT

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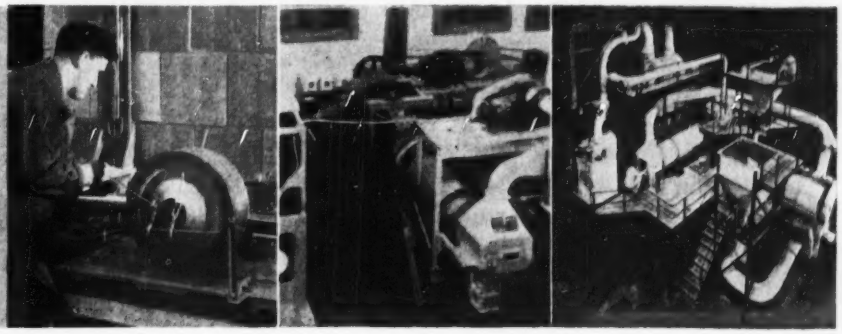
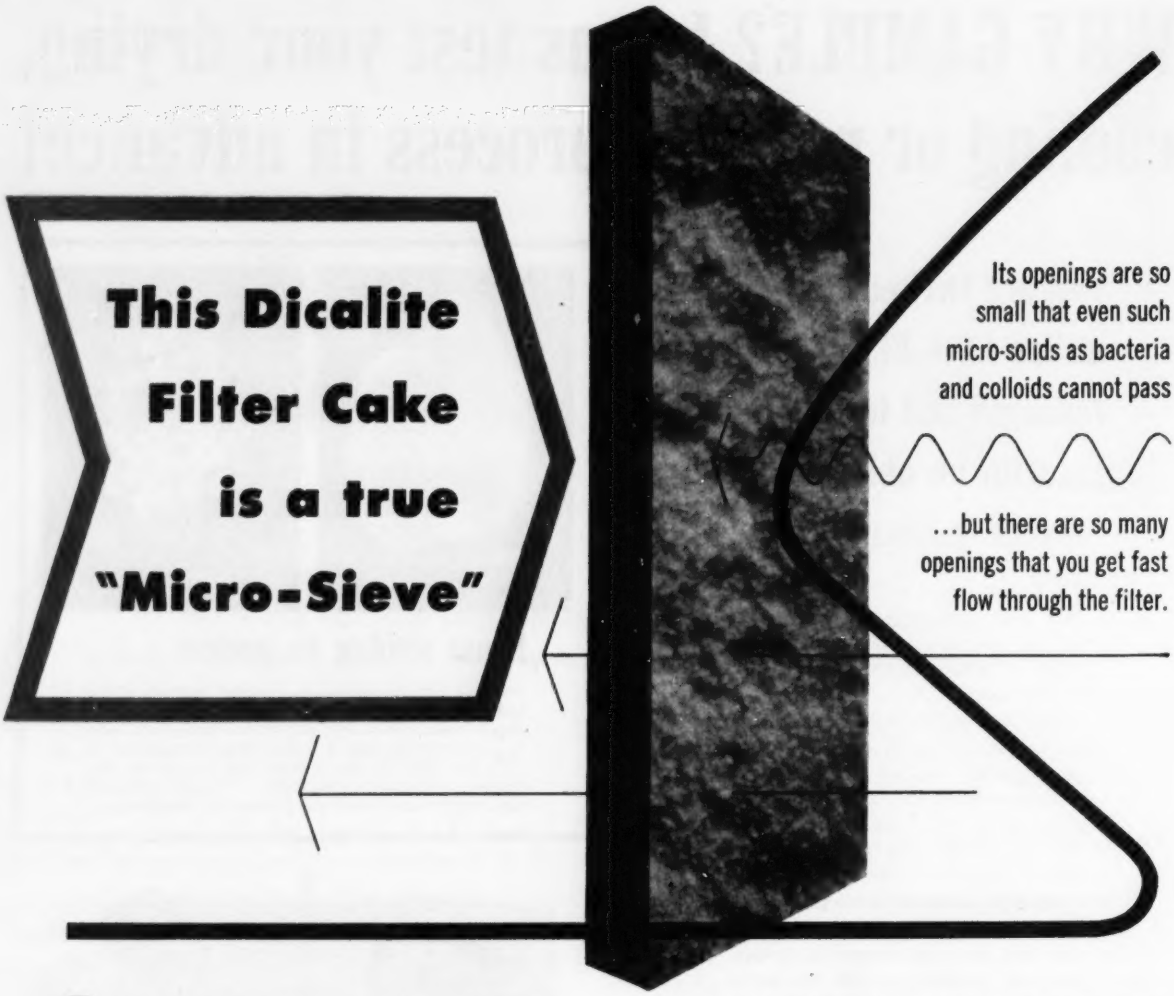
Miniature, reduced-scale and full-scale equipment at Link-Belt laboratories can test-run a pound or a ton of your material



This Dicalite Filter Cake is a true "Micro-Sieve"



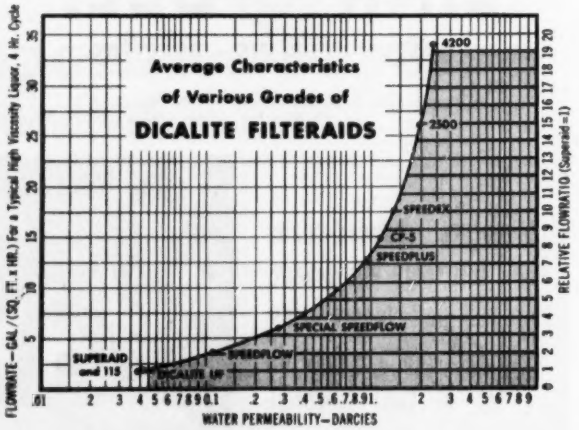
Its openings are so small that even such micro-solids as bacteria and colloids cannot pass

...but there are so many openings that you get fast flow through the filter.

That, in a nutshell, is the reason for both the brilliant clarity and high production achieved with Dicalite filter-aids. This efficiency is directly due to the unique structure of the diatom particles—elongated or otherwise irregular in shape. They build up in a "lattice-work" pattern which makes the filter cake a "micro-screen."

Chemically inert, sterilized in processing, Dicalite is suitable for filtering all types of liquids from acids to zein. It is used in processing hundreds of products including antibiotics, beverages, foods, metals, oils, sugars, varnishes, wines and many others.

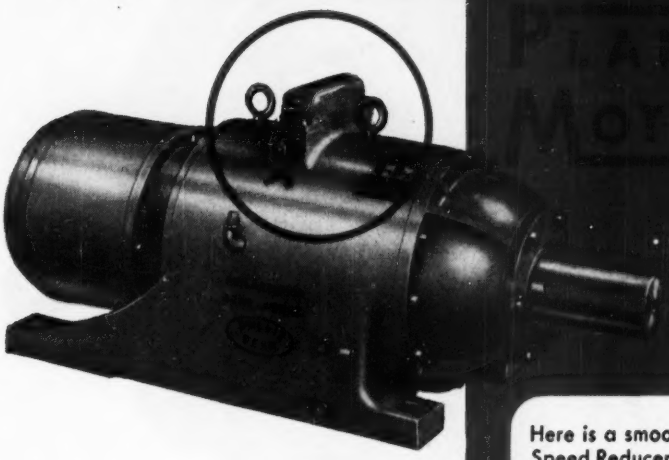
And you can depend on Dicalite quality. Starting with the country's finest crude diatomite, all Dicalite materials are processed under a rigid system of continuous control. Write for Bulletin B-12—or a Dicalite Engineer will be glad to call and discuss a problem or any project you have in the works.



Dependable GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

DICALITE DIVISION • GREAT LAKES CARBON CORPORATION, 614 SO. FLOWER STREET, LOS ANGELES 17, CALIFORNIA

..FOR INSTANT OVERLOAD PROTECTION



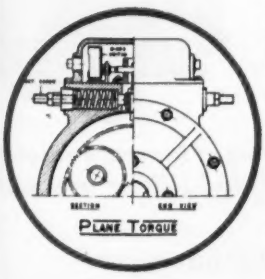
PLANETORQUE MOTOREDUCER

. . . eliminates
shear pins,
electrical relays . . .

Here is a smooth running, trouble-free Motorized Speed Reducer . . . an "exclusive" product, whose design and construction is the result of 61 years of gear making and speed reducer experience. Built in two types, Horizontal and Vertical. The MotoReduceR has many original, outstanding advantages, each of practical value to industry:

- Planetary gear design provides better alignment of pinions and gears, which in turn reduces noise and wear.
- Permits greater reduction ratios in more compact unit than otherwise possible.
- Reducer can be readily disassembled for easy inspection or maintenance.
- Vertical units incorporate "dry well" construction, which eliminates possibility of oil leakage down output shaft.

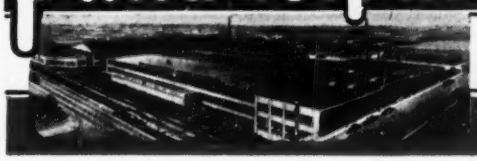
PLANETORQUE



PLANETORQUE is a feature that can be supplied with any Philadelphia MotoReduceR or Philadelphia Planetary Reducer. It safeguards both the driven machinery and drive unit from dangerous overloads. These units are widely used on stoker drives, conveyor drives, mixers, agitators, roll drives, and tumblers, where overloads or jamming may be encountered.

For further detailed information write for PlaneTorque MotoReduceR Catalog.

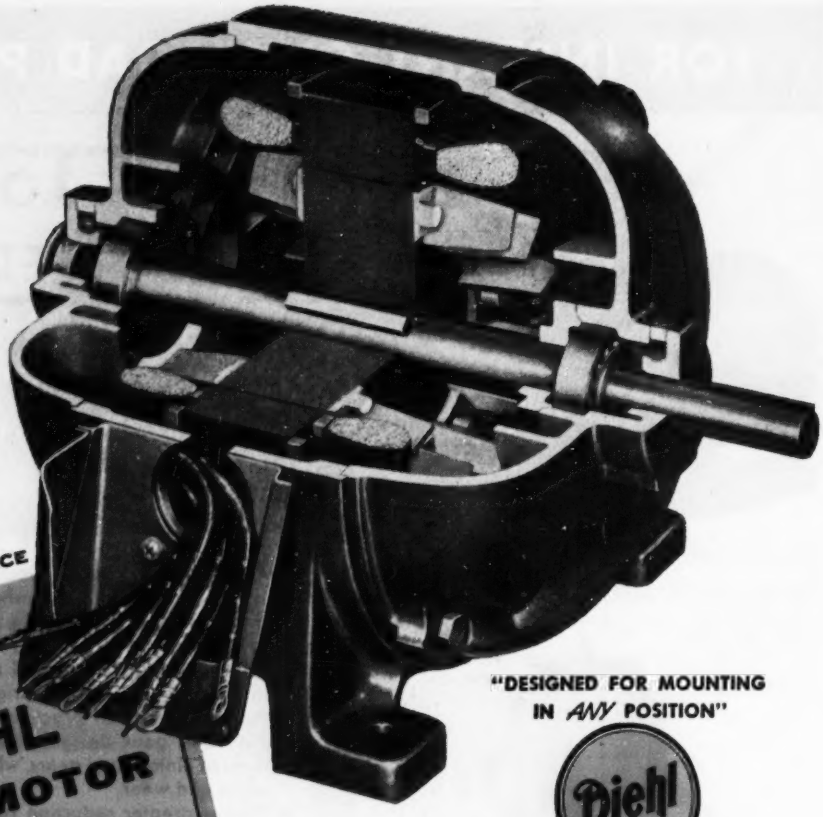
Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



TOPS IN QUALITY
COMPETITIVE IN PRICE

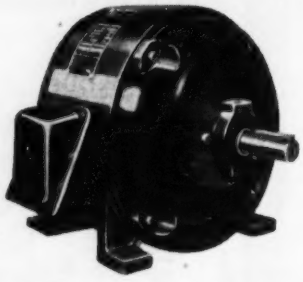
SPECIFY THE New DIEHL TYPE "D" MOTOR

"DESIGNED FOR MOUNTING IN *ANY* POSITION"

Diehl

...here's 12 reasons why

- Most Advanced Slot Insulation
- Machine Fitted Stator
- Rotor Keyed to Shaft
- New High Dielectric Insulated Stator Windings
- Permanently Numbered Leads
- Conduit Box, An Electrician's Delight
- Centrifugally Cast, High Density Rotor Windings
- Rugged Stress-Relieved End-Covers
- New Pre-lubricated Heavy Duty Ball Bearings
- Locked-in Ball Bearing
- Dual Ventilation System
- Extra Strong Cast Iron Frame



Designed and engineered for more efficient performance. Smaller in size, lighter in weight and quieter in operation.

Consult our engineers before writing your specifications and get the benefit of 68 years of experience in the design and manufacture of general and special purpose motors

Diehl motors will still be available in old NEMA Standard frame sizes for interchange and replacement.

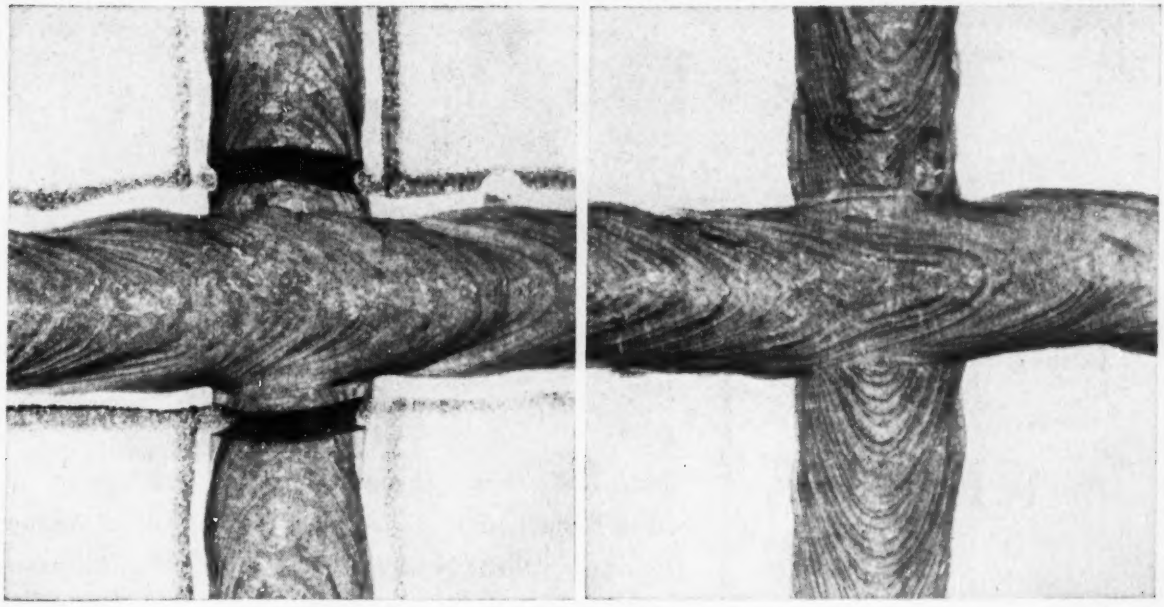
DIEHL MANUFACTURING COMPANY
Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

Please send me the following bulletins

☐ New Type "D" Motor Bulletin No. CE3304
☐ Consolidated Catalog & Price List No. CE3310

Name_____
Company_____
Street_____
City_____ State_____

INTEGRAL AND FRACTIONAL HORSEPOWER MOTORS ARE AVAILABLE IN A WIDE RANGE OF TYPES AND SIZES



Two welded samples were tested for three 4-hour periods in a solution of 10% nitric and 3% hydrofluoric acid at 176 F. Specimen at left showing acid attack alongside welds is regular Type 304; specimen at right, free from acid attack, is Armco 18-8 ELC (Type 304L).

PROTECT WELDED STAINLESS EQUIPMENT AT LESS COST WITH ARMCO ELC

You needn't take chances on carbide precipitation adjacent to welds in chemical equipment. Armco offers two extra-low carbon (ELC) stainless steel grades that are completely satisfactory for service in welded equipment up to 800 F. They are:

ARMCO 18-8 ELC (TYPE 304L)
ARMCO 18-12 MO ELC (TYPE 316L)

THEY SAVE YOU MONEY

Armco 18-8 ELC costs less than the columbium- or titanium-stabilized Types 347 and 321, yet insures the same freedom from intergranular corrosion in the recommended temperature range as the more expensive types. The Armco ELC types are produced in sheets, strip, plates, bars and wire.

"EXTRA-LOW-CARBON" DOES IT

Armco ELC grades contain a *maximum of only 0.03% carbon.* This small amount of carbon is not enough to cause harmful carbide precipitation adjacent to welds during welding. Therefore, stabilizing elements are not needed, for either shop- or field-welding.

GET COMPLETE INFORMATION

Let us send you a copy of the article, "How to Control Carbide Precipitation in Welding Stainless Steels." This is the latest and one of the most concise articles ever written on the subject. For more information on the ELC grades, get the booklet, "Armco's ELC Stainless Steels." Just check what you want on the coupon and mail it to us.

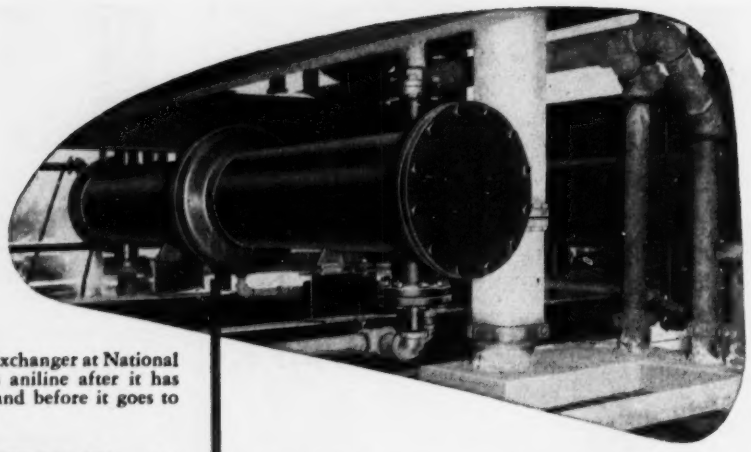
ARMCO STEEL CORPORATION
2514 Curtis Street, Middletown, Ohio

☐ Send me a copy of the article, "How to Control Carbide Precipitation in Welding Stainless Steels"
☐ Send me a copy of the booklet, "Armco's ELC Stainless Steels"

NAME_____
FIRM_____
STREET_____
CITY_____ ZONE____ STATE_____

ARMCO STEEL CORPORATION

2514 CURTIS STREET, MIDDLETOWN, OHIO • EXPORT: THE ARMCO INTERNATIONAL CORPORATION



• ADSCO Heat Exchanger at National Aniline sub-cools aniline after it has been condensed and before it goes to storage.

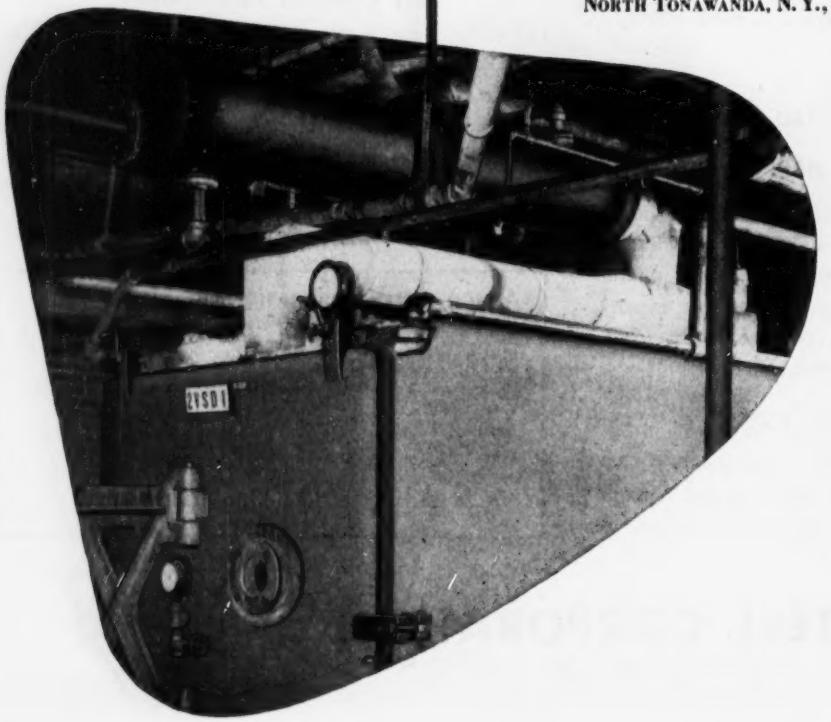
WHERE A HEAT EXCHANGER MUST BE GOOD

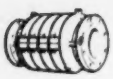
• ADSCO Heat Exchanger (insulated) above vacuum drier at National Aniline condenses organic acid vapor in tubes with water or brine in shell. Exchanger equipped with shell expansion joint.

The ADSCO Heat Exchangers shown on this page are installed in the Buffalo, N. Y., plant of the National Aniline Division of Allied Chemical & Dye Corporation. The manufacturing processes of National Aniline require engineered equipment of the highest caliber. . . . ADSCO, in business since 1877, offers the chemical processing industry a complete line of carefully-engineered heat exchangers built to customers' specifications or to our recommended designs. Inquiries are cordially invited.

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS
NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.





EXPANSION JOINTS

TRAPS

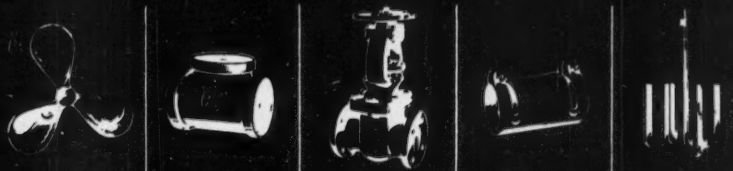
STRAINERS

SEPARATORS

DON'T TAKE OFFICE WORRIES HOME

Relax!

Slip on your robe, cuddle up with a good book and forget about the plant. You've done your best today, and you need relaxation to keep on doing your best. If you've specified Cooper Alloy stainless steel castings, valves or fittings for those corrosive operations, you've put your problem in hands you can trust. Our thirty years of experience is your guarantee of quality products—use them with confidence and . . . relax!



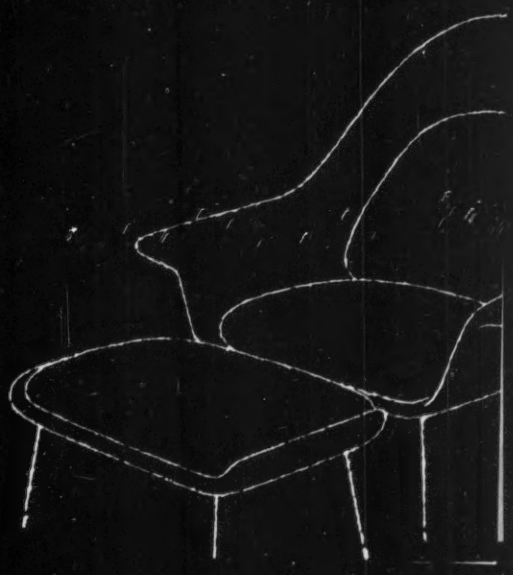
propeller | fitting | valve | Quikupl | mixer

COOPER ALLOY

THE COOPER ALLOY FOUNDRY CO. • HILLSIDE N J

Los Angeles San Francisco Oakland Houston Chicago Detroit Philadelphia Hartford

Leading producers of STAINLESS STEEL valves, fittings and castings



ENTIRELY NEW!

Explosion-Proof! Dust-Tight! Rain-Tight!

CIRCUIT BREAKER, MOTOR STARTER and COMBINATION MOTOR STARTER

UNILETS

REG. U.S. PAT. OFF.

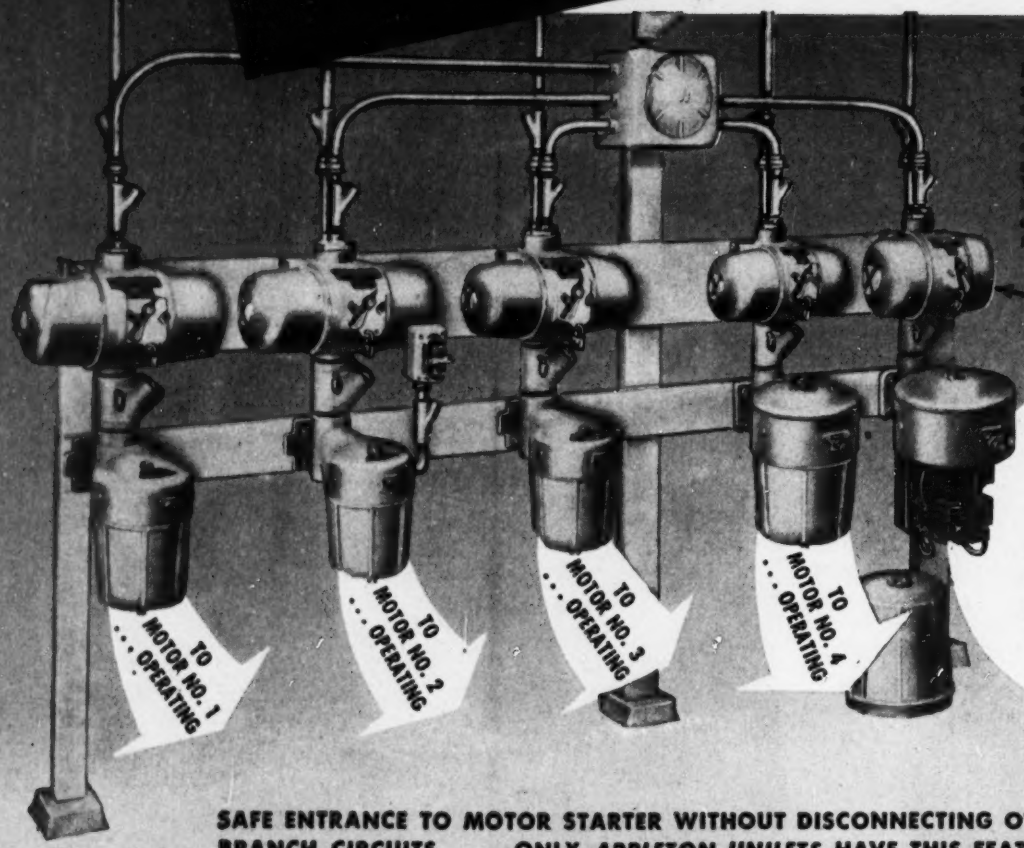


Illustration shows the high safety factor, versatility, and space-saving attributes of *Appleton* explosion-proof circuit breaker and motor starter *Unilet* Combinations. Your own installation needs, no matter what they may be, can also be met with these remarkable new Unilets.

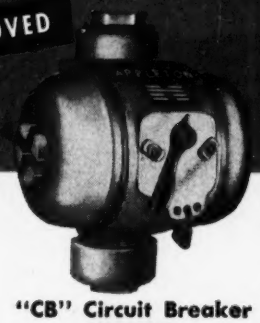
BREAKER LOCKED IN "OFF" POSITION

MOTOR STARTER NO. 5 . . . EXPOSED FOR SAFE MAINTENANCE . . .

but no "down time" on other operating equipment

SAFE ENTRANCE TO MOTOR STARTER WITHOUT DISCONNECTING OTHER BRANCH CIRCUITS . . . ONLY *APPLETON UNILETS* HAVE THIS FEATURE!

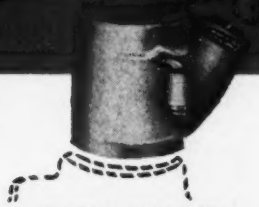
U. L. APPROVED



"CB" Circuit Breaker UNILETS

Assure easy, safe, flexible, and economical installation for protection of service entrance, feeder or lighting, appliance, and branch circuit conductors up to 225 amperes. U. L. Approved individually and in banked groups up to three for forms 1 and 2 without using dividing seal.

U. L. APPROVED



Sealing UNILETS

Available for use as explosion-proof seal where needed on circuit breaker and motor starter Unilets. This Sealing Unilet is furnished on all Combination Motor Starters, and when properly sealed permits safe entrance to a motor starter in single or banked combination installations, without disconnecting other branch circuits.

U. L. APPROVED

"LS" Motor Starter UNILETS

For 3-phase induction motor control up to 100 H.P. at 600 volts maximum. Lightweight construction of larger sizes eliminates need for heavy lift equipment . . . assures easy, time-saving, inexpensive installation. Also made for reversing and two-speed motors.

The greatest advance in explosion-proof design in years!

● You expect more from *Appleton,* and you get it! The proof lies in these completely new and different *Appleton* circuit breaker and motor starter *Unilets.* Alone or in combination, their design, construction, and performance give you maximum safety, unparalleled ease of wiring, installation and maintenance, and initial and long-term money savings not available with any other equipment! You'll find their exclusive features invaluable on any hazardous-location motor control or power lead-in installation, large or small, indoors or outdoors, where tricky wiring, corrosive and flammable atmospheres, dust, or weather difficulties appear insurmountable. Where absolute safety is required day in and day out and every minute of the day, you can place complete confidence in *Appleton Unilets.*

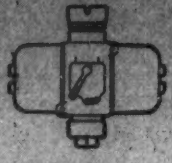
IMPORTANT ADVANTAGES

- **FIRST to be U. L. Approved for BANKED Circuit Breaker Grouping**
- **Combinations Meet U. L. Requirements through Approval of Components**
- **FIRST to Achieve Safe Entrance to Motor Starter of a Combination without Shutting Off Other Branch Circuits**
- **Full 7-Thread Explosion-Proof Protection . . . No Bolts to Strip or Flanges to Nick**
- **Unmatched Accessability for Easiest Wiring and Servicing on Every Job**
- **Light-Weight Construction for Easy Installation without Heavy Lift Equipment**
- **Quick Interchange on All Leading Makes of Circuit Breakers and Motor Starters**
- **Flexible Field Set-ups Assured with Single and Duplex Male and Female Hub Adapters**

BANKED CIRCUIT BREAKER GROUPING
Male to female hubs permit easy grouping. Cuts costs, streamlines panel set-ups, assures coordinated control without sacrificing safety. U. L. Approved up to groups of three in smaller size Unilets.

VERTICAL "STRAIGHT-THRU" DESIGN
Simplifies wire pulling, saves time. Ample working space eliminates need to remove breaker mechanism from enclosure, yet assures clean, safe wiring.

Patent Applied For



OVER-SIZE CONDUIT and CONDUCTORS
May be run with hub adapters for subsequent installation of higher rated breakers without replacing complete Unilet or existing conduit.

PUSH-BUTTON and PILOT DUTY CONTROL
Combines convenience and selectivity including built-in "Start-Stop," "Hand-Off-Auto.", or "Jog-Run-Off" control where needed.

Sold Nationally Through Electrical Wholesalers

APPLETON ELECTRIC PRODUCTS

APPLETON ELECTRIC COMPANY
1742 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Also Manufacturers of:

Explosion-Proof Fixtures

Industrial Lighting

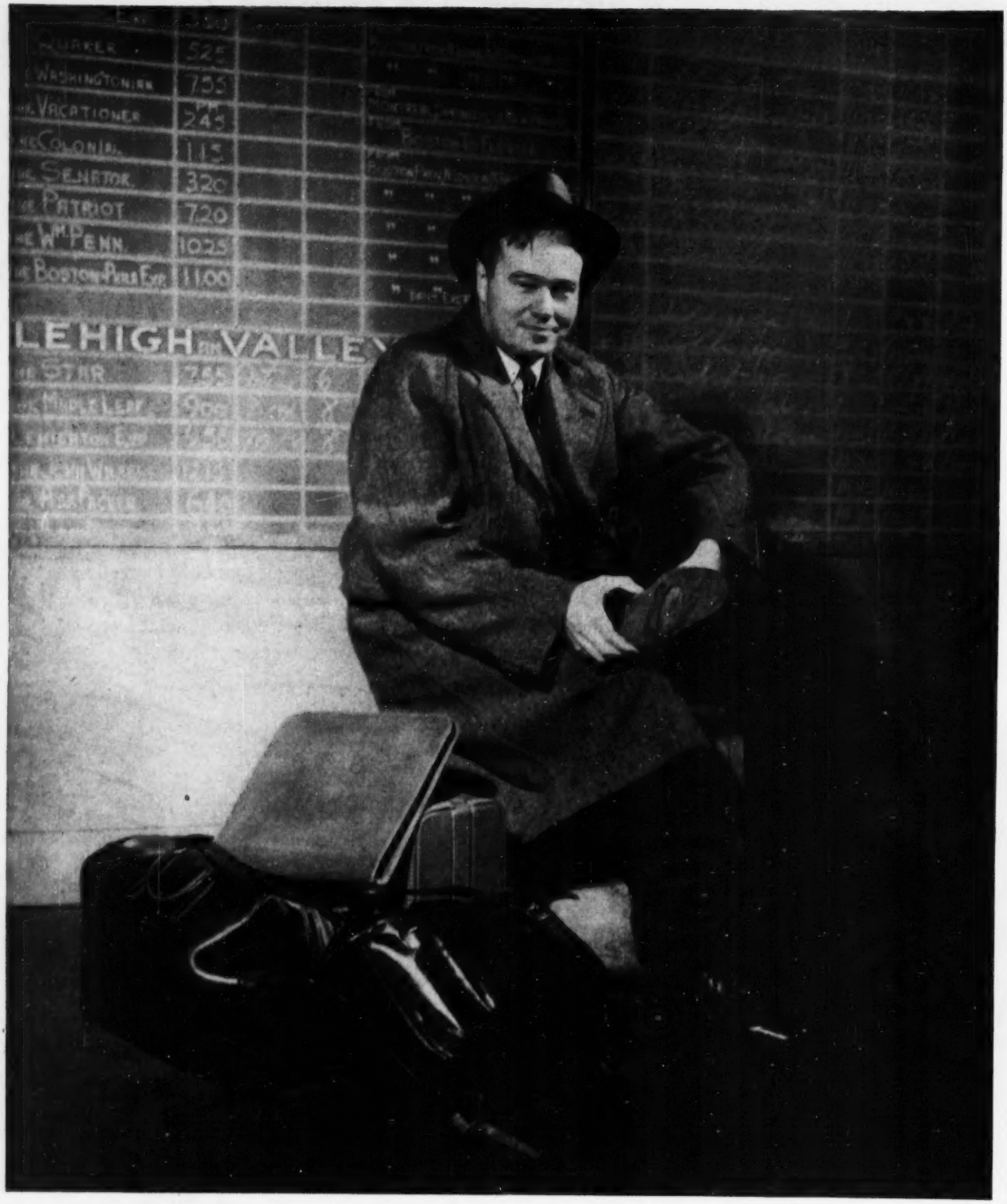
"ST" Liquid-Tight Connectors

Automatic Reelites

Outlet Boxes, Covers, Switch Boxes

WRITE TODAY FOR BULLETIN BH
A complete catalog section containing informative technical data.

Rely on APPLETON . . . *The Standard for Better Wiring*



more engineering-minded men read it . . .

* *Morgan Hoover,*
Associate Editor of
CHEMICAL ENGINEERING

wearing a little thin there, Morgan?*

They sure are! CE's "Annual Inventory Issue" has the staff really traveling. But this kind of hustle will pay off with one of the most useful services CHEMICAL ENGINEERING ever delivered. But let Associate Editor Hoover give you the lineup for this September Special . . .

"Me? I'm only working on one phase – new construction is my baby – but I'll be glad to sound off on the overall picture.

The 'Inventory Issue' is a 12-month summary of significant developments affecting the chemical engineer. It's designed for quick, easy reference. The content's loaded with practical, compacted facts. It'll give you an all-in-one-spot handbook radically different from anything else in the field. It's got everything.

'Like what?' you say. Like this outline says, that's what! Here are the six departments featured in the inventory number...

PLANTS & FACILITIES – A thorough round-up of all major CPI construction activity announced or under way during the past 12 months (by industry, location, investment, products and capacity of output). The result of a year's survey by CE editors.

PROCESSES & TECHNOLOGY – Another wholly original feature, built on an idea created by us in 1951, and still exclusive. One of the most popular presentations of directory material ever tested on CE's readers.

EQUIPMENT & ACCESSORIES – Easy-to-scan, easy-to-use digest of all important new equipment introduced during previous 12 months. Special format utilizes tightly written descriptive treatment of latest developments with wide appeal throughout the field.

PRODUCTS & MATERIALS – Similar to Equipment section, but based on CE's Product News department. Digest and format completely original, an innovation in business paper publishing. All items carefully categorized and alphabetized within categories.

TECHNICAL LITERATURE – For the first time, a manufacturers' literature library is indexed in a single publication. A complete, efficiently organized and highly usable inventory of new technical literature. To cover not only equipment, but materials and services too.

READER SERVICE – A complete check-list of every product advertised or described editorially. Brand new method of indexing by major product groups . . . a simplified and streamlined presentation with maximum usability for the reader.

That's a quick preview, readers. It's a big order but you'll agree it's worth waiting for. What's more, it's a reference that'll never wear out! You can build up a permanent library because we're going to keep bringing them to you every year from now on.

Yipe! My train's in! Gotta run now and see a man about some new plants. You'll be reading about 'em come September. More on this 'Inventory Issue' next month. So long!" *Morgan Hoover*, Associate Editor.

more chemical engineers profit from it...

Chemical Engineering

A McGRAW-HILL PUBLICATION

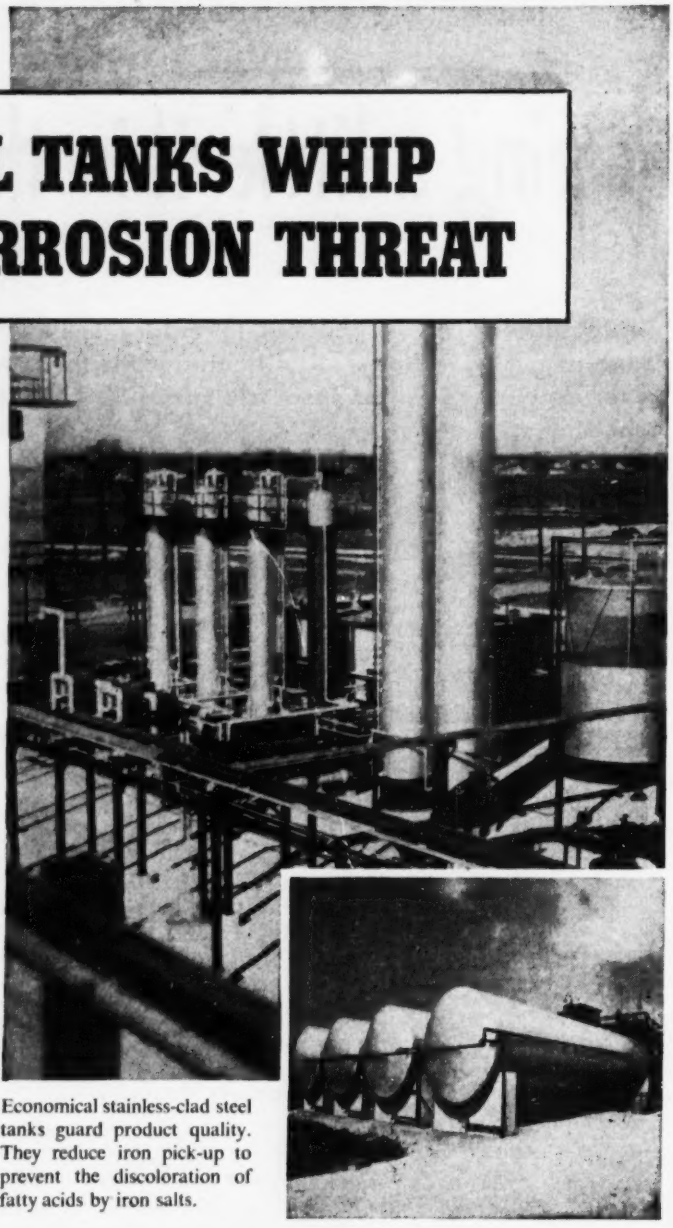
330 WEST 42nd ST., NEW YORK 36, N.Y.

CLAD STEEL TANKS WHIP CHEMICAL CORROSION THREAT

A critical corrosion problem faced this chemical producer. In a plant that can process up to 100 million pounds of fats and oils annually, unsaturated acids and moisture would cause fatty acids to attack iron during storage. Presence of iron salts would threaten instability and as little as 30 to 40 parts of iron per million are enough to darken fatty acids. With lighter colors getting a premium price and output headed for high-grade consumer products, product quality had to be protected. The answer: economical clad steel equipment ended the danger of corrosion during storage, virtually eliminated iron pick-up.

Cooperative planning between the designers and equipment builder solved this problem. Stainless-clad steel was specified for four horizontal feed tanks, two settling tanks and two insulated cone roof storage tanks. Here a light layer of cladding provides the smooth, corrosion-resistant surface of more expensive solid alloy, while the low-cost carbon steel backing gives strength and rigidity. Integral and permanent bonding of cladding and backing prevents seepage of acid to the backing. Smooth contours and joints possible with clad permit easy cleaning and lessen the chances of contamination.

If you are looking for economical product protection, follow the profitable lead of this chemical producer. Call in your equipment builder *early* in your planning of new equipment. Working with your engineers and consultants, he can contribute his skill, know-how, and understanding of your field to give you the low-cost, long-lived clad steel equipment your process demands.



Economical stainless-clad steel tanks guard product quality. They reduce iron pick-up to prevent the discoloration of fatty acids by iron salts.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 678 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

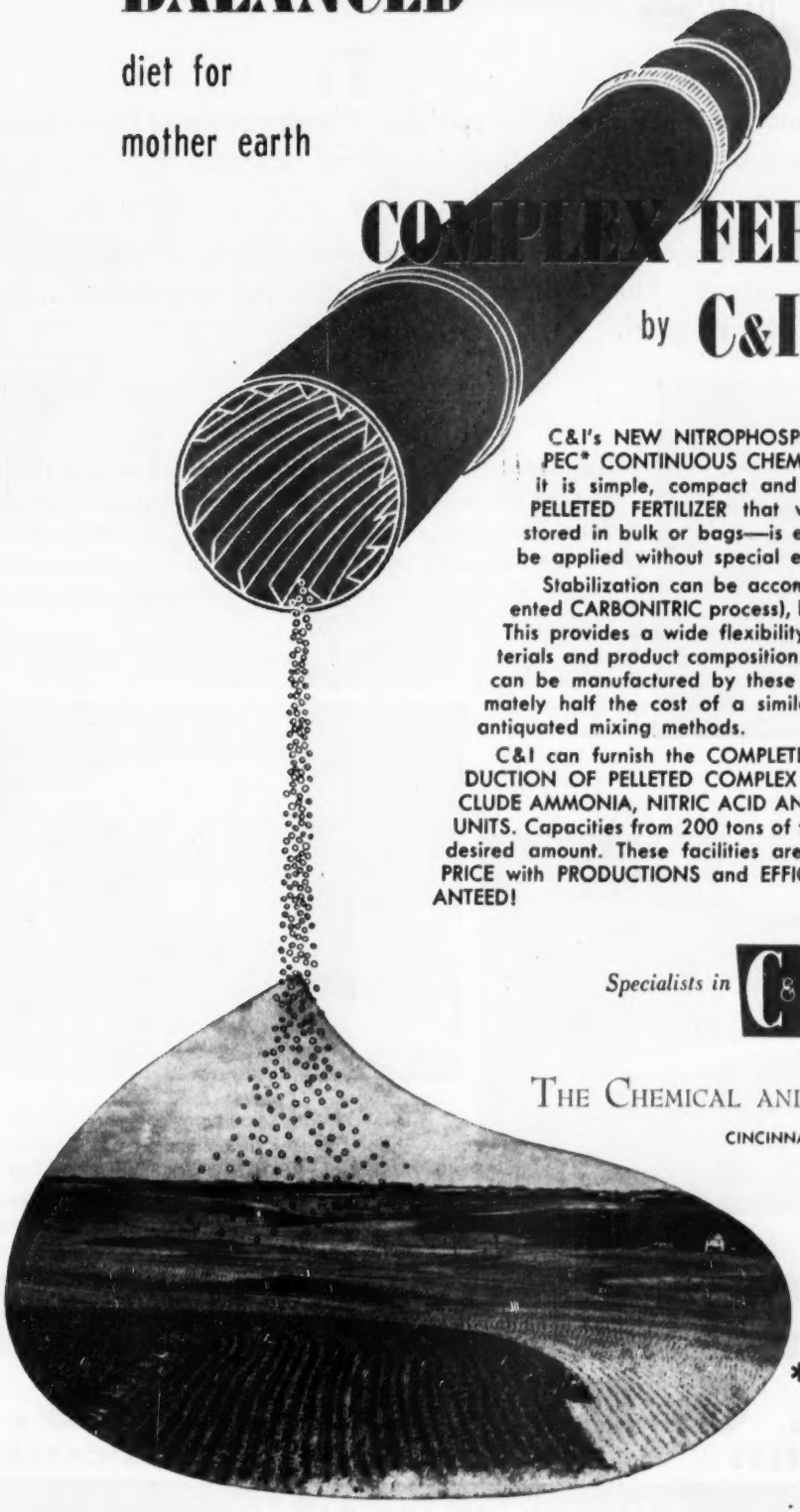
PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

each pellet . . a

BALANCED

diet for

mother earth



COMPLEX FERTILIZER

by **C&I**

C&I's NEW NITROPHOSPHATE PLANT USES THE PEC* CONTINUOUS CHEMICAL PROCESSES . . . . it is simple, compact and produces a SUPERIOR PELLETED FERTILIZER that will not cake—can be stored in bulk or bags—is easy to handle and can be applied without special equipment.

Stabilization can be accomplished with CO_2 (patented CARBONITRIC process), H_2SO_4, H_3PO_4 or K_2SO_4. This provides a wide flexibility in choice of raw materials and product composition. High analysis fertilizer can be manufactured by these processes for approximately half the cost of a similar grade produced by antiquated mixing methods.

C&I can furnish the COMPLETE FACILITIES FOR PRODUCTION OF PELLETED COMPLEX FERTILIZER WHICH INCLUDE AMMONIA, NITRIC ACID AND COMPLEX FERTILIZER UNITS. Capacities from 200 tons of fertilizer per day to any desired amount. These facilities are available at a FIXED PRICE with PRODUCTIONS and EFFICIENCIES FULLY GUARANTEED!

Specialists in C&I *Processing Ammonia*

THE CHEMICAL AND INDUSTRIAL CORP.

CINCINNATI 26, OHIO

* Potasse et Engrais Chimiques

PEC

KELLEY

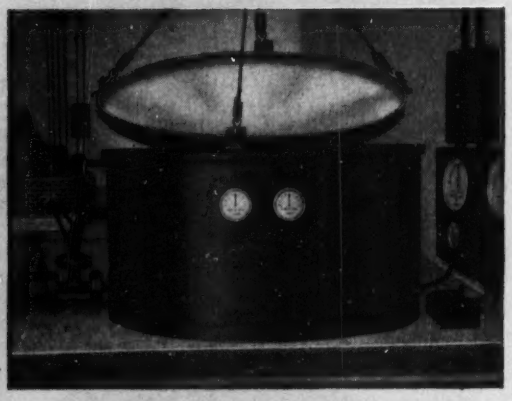
Pioneers in HOMOGENEOUS LEAD BONDING

First Again with a "NEW MECHANICAL"* Bonding Process

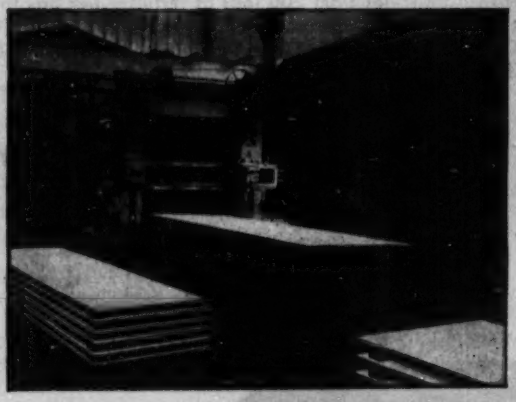
*Our newly developed "mechanical" process for applying **Homogeneous Lead Bondings** affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.

Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.



To insure uniform overall thickness of the Homogeneous Lead Bondings and eliminate the human errors occurring in other methods, lead is applied "oversize" to flat sheet plates and then planed to required thickness. In addition, this operation affords considerable savings in time over the general "Hand Scraping" method.



Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

KELLEY Custom-Built for the Processing Industries

TANKS · LEAD COILS · LEAD & LEAD LINED VALVES
SHEET LEAD LININGS · CASTINGS & FITTINGS

STAINLESS STEEL
LEAD
WOOD
STEEL
Fabrication

O. G. KELLEY & CO.

ENGINEERS DESIGNERS FABRICATORS

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CLEVELAND, OHIO · NEW YORK, N.Y. · PITTSBURGH, PA.
JOHNSON CITY, TENN. · HOUSTON, TEXAS · ELIZABETH, N.J.

Dependable Source for Chemical Raw Materials

Ralph Fieldsend, General Manager and Secretary of Hudson Worsted Company, Hudson, Mass., and Frank Ledger, Superintendent, inspect a batch of wool after scouring.

"We have been a Wyandotte Soda Ash user for over 40 years"

– Ralph Fieldsend, Hudson Worsted Company

"We have a very unusual company in these days of management turnover," says Ralph Fieldsend, General Manager and Secretary of Hudson Worsted Company, Hudson, Mass. "Our company has been under the guidance of one president for 58 years. A good supplier stays with us, too — for more than 40 years, we have been a constant user of Wyandotte Soda Ash in our wool scouring processes.

"We know that to have good sources of chemical raw materials is a 'must' in our business. We also appreciate that the chemical industry is a growth industry, and, as such, can play an important part in all industries, including our own.

"While processes haven't changed in years in commission wool combing, still the need for quality has never diminished. Consequently, we demand the highest quality materials from our suppliers."

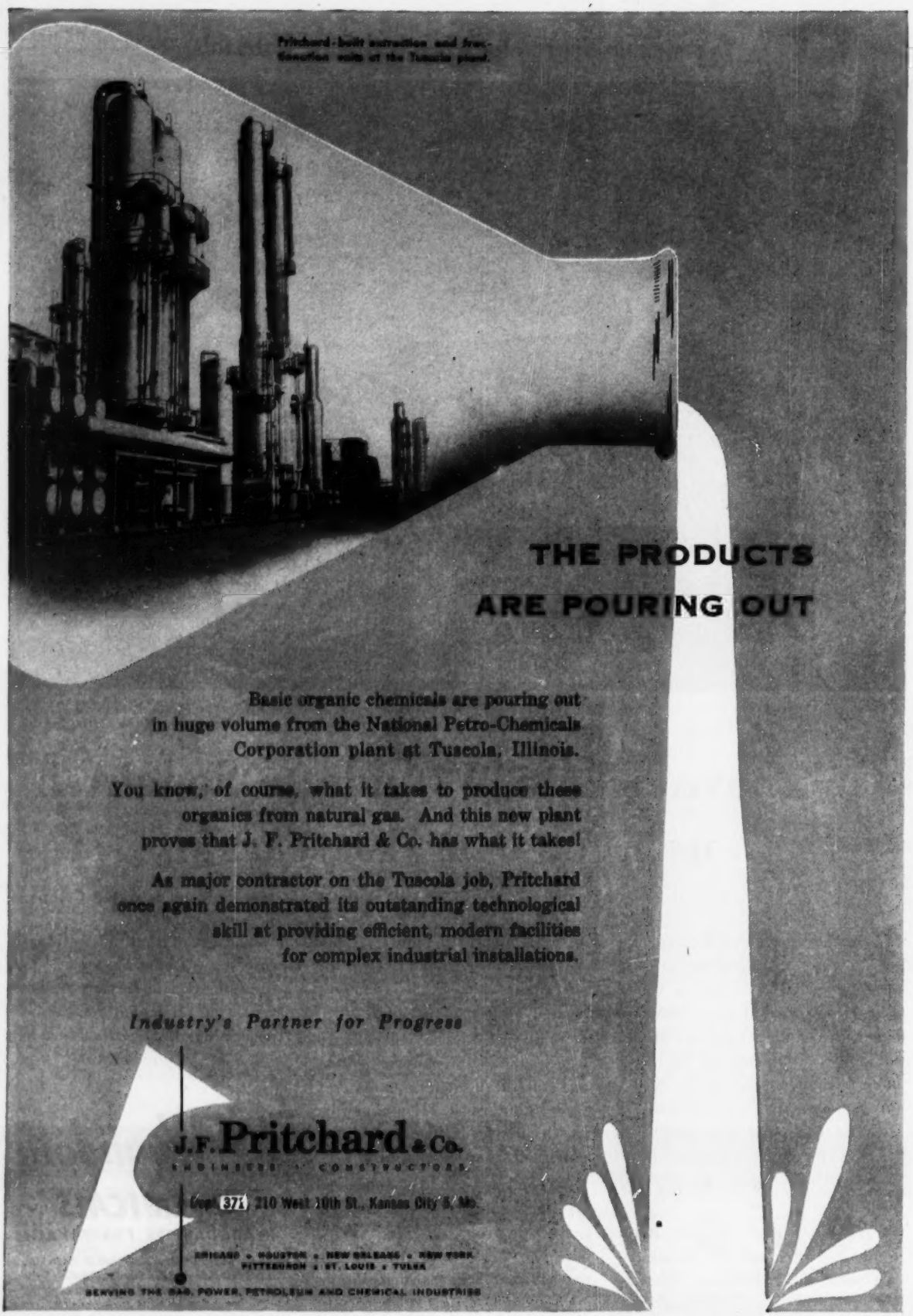
Do you want a source of chemical raw materials that is a working partner in your progress? You'll find one in Wyandotte . . . a partner that believes in maintaining the highest quality in present products, and that is continually searching for new products to aid the industries it serves. May we serve you? *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

Wyandotte

CHEMICALS

HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine
Calcium Carbonate • Calcium Chloride • Glycols • Synthetic Detergents • Agricultural Insecticides • Soil Conditioners
Other Organic and Inorganic Chemicals


Pritchard-built extraction and fractionation units at the Tuscola plant.
THE PRODUCTS
ARE POURING OUT
Basic organic chemicals are pouring out in huge volume from the National Petro-Chemicals Corporation plant at Tuscola, Illinois.
You know, of course, what it takes to produce these organics from natural gas. And this new plant proves that J. F. Pritchard & Co. has what it takes!
As major contractor on the Tuscola job, Pritchard once again demonstrated its outstanding technological skill at providing efficient, modern facilities for complex industrial installations.
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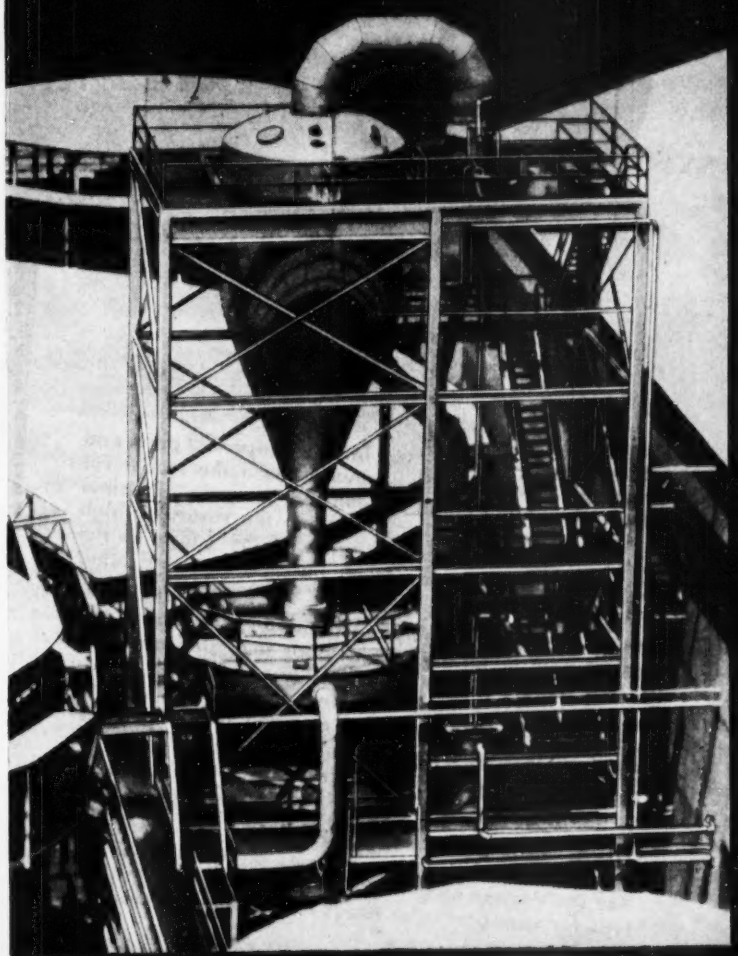
KRYSTAL



VACUUM
CRYSTALLIZER
FOR PRODUCING
NON-CAKING,
UNIFORM
CRYSTALS

Crystalline materials such as potassium nitrate processed in the Krystal equipment illustrated are uniform in size, non-caking, dust free, and easily separated from mother liquor in filter or centrifuge.

Krystal crystallizers can be operated for long periods without shutdown time for cleaning. Here, Krystal produces crystalline materials of higher purity with greater economy.

Our crystallization engineers are available for consultation on your crystallization problems.

Write for Bulletin 55-A which describes the principles and applications of vapor crystallizer equipment.

KRYSTAL
stands for quality
throughout
the world

STRATFORD-WELLS CORPORATION
WARREN, PA.
Plants at Warren, Pa. and Newark, N.J.
Offices in Principal Cities

...invisible values

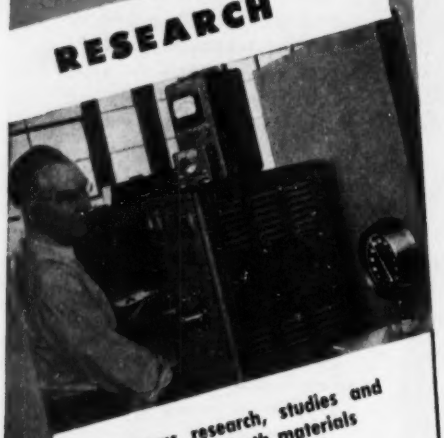
Separate an Ashcroft Gauge into its component parts and many of the reasons that have made it the leader for over a century remain unseen. For they are invisible values . . . equally as important to the sustained high accuracy and long-life endurance of the gauge as the Bourdon Tube, the movement, linkage, case and other components.

Creative research, highly functional design, quality control of both materials and methods and rigid manufacturing standards are "built into" every Ashcroft Gauge . . . are the fundamental reasons why high performance standards are expected and attained in every gauge bearing the Ashcroft Shield.

The new Ashcroft Gauge Catalog 300 is now available. Write for a copy.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is thoroughly acquainted with the various lines of Ashcroft Gauges. You can depend on him to help you in selecting the right type for your particular needs—and to deliver promptly.

RESEARCH



Continuous research, studies and tests guarantee both materials and methods.

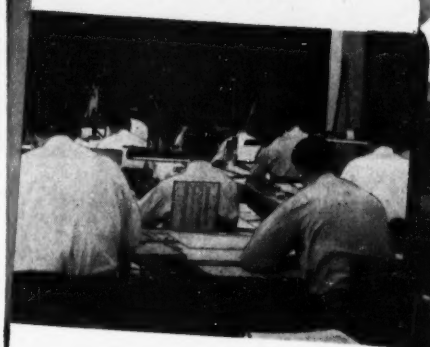
Completed designs as well as individual components are subjected to "breakdown" tests in the Research Laboratory pictured here. These tests subject all materials and methods to vigorous analyses . . . are designed to keep Ashcroft ahead of future as well as current gauge requirements regardless of industry demands.

ASHCROFT GAUGES

of ASHCROFT GAUGES

1850 ASHCROFT U.S.A.

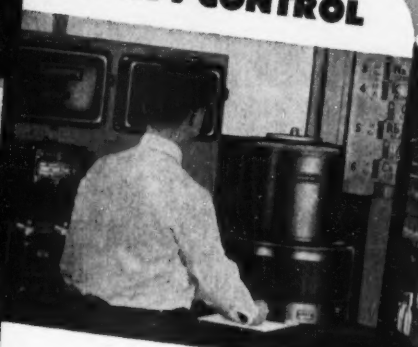
DESIGN



Sustained accuracy is the major objective of the design function.

Where research largely determines materials and methods to be used, the design function is primarily concerned with sustained high accuracy. The drafting room shown above is one of the most essential "creative centers" in the progress of an Ashcroft Gauge from original research to finished product.

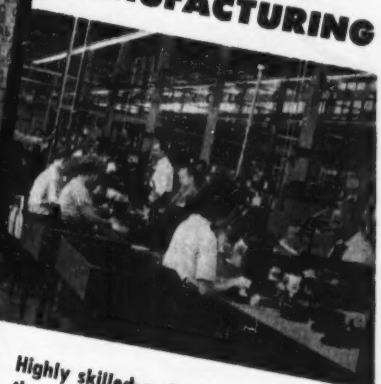
QUALITY CONTROL



Ashcroft metallurgists subject all raw materials and parts to thorough examination and tests.

Augmenting research and design, quality control exhaustively examines, for functional surety, all materials used in the gauge as well as the finished product. No substitute for final inspection, quality control "guards the gauge" from original design to final manufacture.

MANUFACTURING



Highly skilled craftsmen command the most modern equipment and plant facilities to assure manufacturing excellence.

This unbeatable combination produces the Ashcroft Gauge . . . an achievement in metal . . . first conceived by Ashcroft research and design engineers and completed by unmatched production techniques. Pictured is one of the assembly sections where perfection of gauge performance is considered a manufacturing challenge as well as a responsibility.

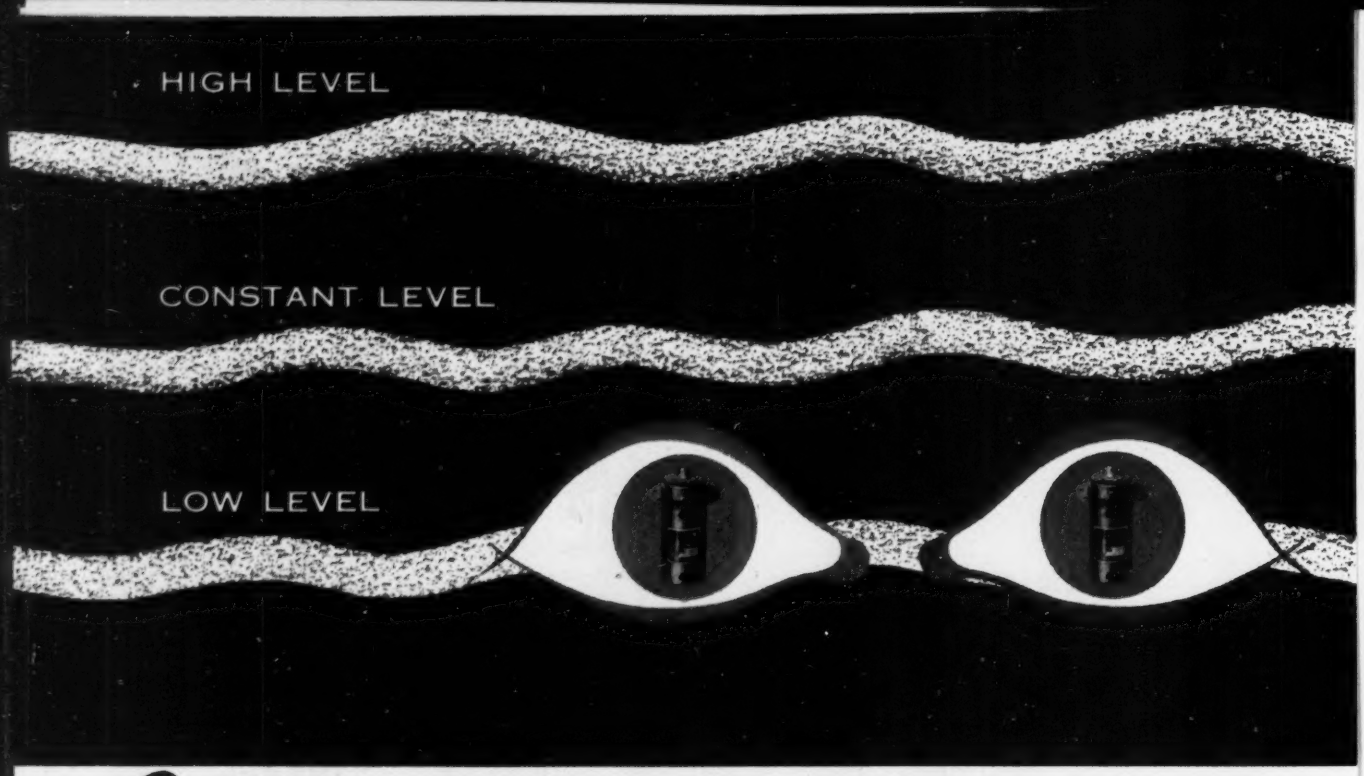
1850 ASHCROFT U.S.A.

A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

MAXWELL MANNING TRADE MARK

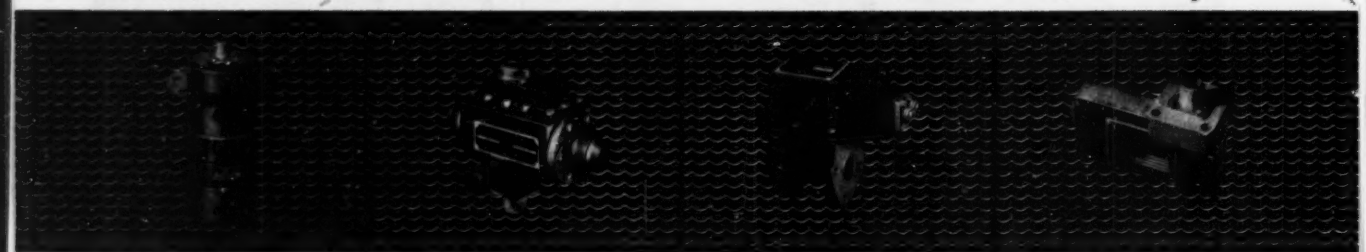


Revere INSTRUMENTS SEE WHERE YOU CAN'T

See *Revere* . . . if you need to know — HOW MUCH LIQUID — HOW LITTLE — AT WHAT LEVEL. *Revere's* precision made instruments are your unfailing eyes that see into sealed tanks, tubes or complex fuel lines. They can provide you with accurate measurement of liquid level regardless of pressure or temperature changes, vibration or rapid acceleration forces, AND they will automatically transmit a warning signal whenever liquid flow or level maintenance varies from a pre-determined value.

These hermetically sealed, magnetically actuated instruments employ balanced float assemblies to minimize false alarms. Compact and light, Revere instruments meet government specifications. They are available in many different configurations, some of which include relays to handle heavy electrical loads. Others are designed for complete submersion in fluids.

*Submit your control problem to our Field Engineering Department today. Revere will provide the instruments to tell you — **HOW MUCH — HOW LITTLE — AT WHAT LEVEL.** Shown below are some instruments that are the seeing-eyes of aircraft and industry.*



FLOAT SWITCH
Specially designed with single or dual float systems to provide automatic cut-off control for single point high pressure refueling.

FLOW SWITCH
Provides instantaneous warning signal whenever liquid flow falls below a pre-determined value. It can be mounted in any direction.

INDICATING SWITCH
Records the presence of fluid in a line whether stationary or flowing and transmits a warning signal if fluid condition changes.

FLUID LEVEL SWITCH
Used to maintain accurate high level, low level or constant level control of fuels, water-alcohol mixtures, beverages, etc. and other liquids.

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precision instruments for aircraft and industry

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PLATINUM METALS CATALYSIS

In many procedures, production control, purity of end product and cost of catalysis are brought to peak efficiency through the use of one of the Platinum Metals Catalysts.

If catalysis is part of your production or if you are developing a new process or product involving a catalytic stage, the platinum metals catalysts certainly warrant your investigation. A Baker research representative will be glad to assist.

Baker developed catalysts are helping to lower catalysis costs and provide many important production advantages for large and small-scale manufacture of industrial chemicals and pharmaceuticals. Here, the world's largest facilities for platinum metals catalyst research and production and our vast experience in this field, are at your service—in full confidence, of course. We'll be pleased to have you call or write.

THE PLATINUM METALS CATALYSTS ARE NOW USED FOR:

HYDROGENATION · OXIDATION
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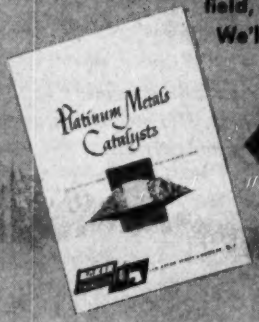
PHARMACEUTICALS · VITAMINS
TERPENES · HYDROCARBONS
GASOLINE DYESTUFFS
INTERMEDIATES
AMMONIA OXIDATION
HYDROGEN CYANIDE

●

PURIFICATION OF HYDROGEN, NITROGEN · PRODUCTION OF INERT ATMOSPHERES, REMOVAL OF OXYGEN, CARBON MONOXIDE FROM GASES

●



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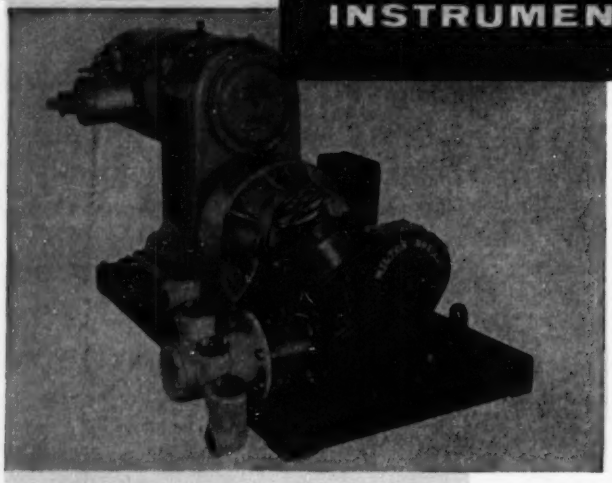
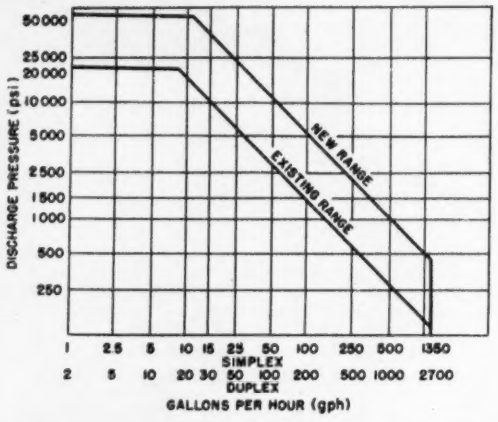
THE HUB OF PLATINUM METALS RESEARCH

CONTROLLED VOLUME PUMPS ARE FLOW-CONTROL INSTRUMENTS



This particular model is used for pressures up to 7500 pounds per square inch. A pneumatic piston positioner (top left) automatically regulates pumping speed in response to a 3-15 pounds per square inch instrument air signal.



Capacity and pressure range of the HyROYmetric Controlled Volume Pump compared with former capacity and pressure range of Milton Roy Pumps.

HERE'S THE NEW HYROYMETRIC®..

For Metering Accuracy at Higher Pressures and Capacities

Here's a new Milton Roy Flow-Control Instrument—to fill the growing industrial need for precision metering of liquids in the higher pressure ranges.

Capacity range:.....1 pint to 2700 gallons per hour

Maximum pressure:.....50,000 pounds per square inch

Capacity regulation:.....Manual or automatic and fully adjustable while in operation

Drive:.....Air or electric motor

Materials:.....Full alloy selection

The HyROYmetric is just one member of a complete line of Milton Roy Controlled Volume Pumps. Our engineering service includes sizing of equipment, proper instrumentation, panelboard design and construction, and all other details as part of the complete service available to you at no extra cost.

Reference Literature—Write for Bulletin 1153-A "HyROYmetric" and Bulletin 553 "Motor-Driven Controlled Volume Pumps."

MILTON Roy COMPANY

Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

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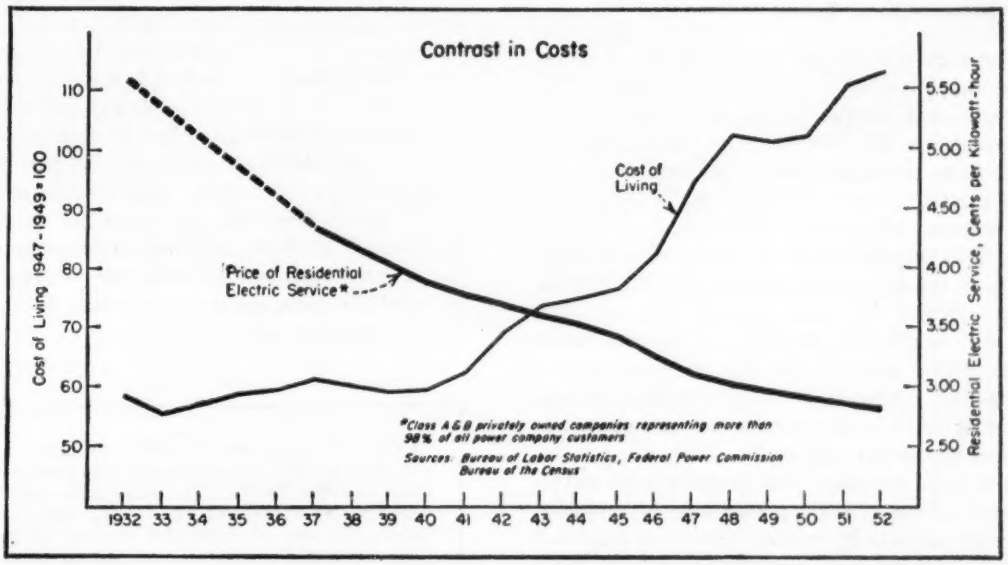
CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

A 20-YEAR RECORD...

The Electric Power Companies' Case for Public Confidence

An economic study of the record of the investor-owned electric power companies of the United States over the past twenty years underwrites their claim to public confidence today. A key factor of this record is set forth by the chart in the middle of this page. This shows that while the cost of living as a whole has almost doubled, the average price of electric energy for residential use in the United States has been cut in half.



The average prices of industrial and commercial power also are much lower than they were twenty years ago.

Such a study confirms the record on other key accomplishments of the electric power companies during the past two decades.

They have not failed, either in peace or war, to meet the nation's rapidly expanding electric power requirements. In paying tribute to the performance of these companies during World War II, J. A. Krug, Director of the Office of War Utilities, said, "Power has never been too little or too late." The same can be said for the entire period of the past twenty years.

To be ready with enough power – on time – the electric power companies have expanded their production fourfold since 1933. This has required an investment of over $17 billion in new facilities. To raise the funds for this investment they have enlisted the participation of about 3 million direct stockholders. Through life insurance companies, banks and similar institutions, about 90 million Americans – more than half of the nation's total population – have become investors in electric power companies. By thus relying on private investment for their expansion, the power companies have provided their

plant and operating equipment without burden on the taxpayer.

In addition, the investor-owned companies have paid about $12 billion in taxes to various governments – national, state and local – over the past twenty years. Unlike government-owned and -operated systems, they have received no public subsidies. When taxes and subsidies are taken into account, the rates for electricity charged by the investor-owned companies have been as low as, or lower than, those charged by government-owned and -operated systems.

Many Americans do not appreciate the job that the power companies have done over the past two decades. That is due, in part, to the public memory of financial abuses by some utility holding companies during the 1920's. This memory obscures a clear and unprejudiced view of the progress since those days. And some of the all-out advocates of reliance on government rather than on regulated private enterprise for the development of our power resources do their best to keep this memory of the past alive in the present.

An Impressive Case

Some special cases of electric power development may involve problems for which the investor-owned companies are unable to provide full solutions. This may be true, for example, of some large multiple-purpose projects that combine electric power generation with related developments such as the improvement of navigation, flood control and the irrigation of arid lands. Some of the economic and administrative problems imposed by such projects are not well adapted to effective handling by private enterprise. Flood control and the improvement of navigation, for example, usually involve the provision of much costly service over and above the cost of producing power.

It is true, however, that in some cases development of the electric power side of multiple-purpose projects by private enterprise may well be more feasible than would appear from statements by some government power advocates. And the record indicates that even in those projects on which both the power generation and the other services are handled by public authority, it may well be desirable to have the investor-owned companies assume the transmission and distribution functions.

Our study of the record of the investor-owned and -operated companies over the past twenty years has led us, of course, behind the statistics that bear on the wisdom of giving them a priority in the development of our power resources. It reveals that these enterprises are manned by people who, through lifetime experience, are peculiarly conversant with the needs of the communities they serve. They have given the consumer notably good service while conforming to standards set and enforced by public regulatory commissions. They have won the confidence of the investing public. By their nature and their experience they are competent to handle any power program that can be demonstrated to be economically sound.

The Paramount Public Interest

By their economic performance during the last twenty years, the electric power companies have earned the confidence of the public. By relying on these companies to meet its electric power requirements the public will fully protect its economic interest in ample and efficient service at fair prices.

That is where our study comes out. Our findings do not touch the political consideration that private operation of electric utilities under public regulation is a safeguard against further concentration of both political and economic power in a federal government that already commands too great a concentration. But if these findings make an economic case for preferring power development by tax-paying business as against power development by governmental agencies, they clear the way for an appeal to the paramount public interest in safeguarding our personal and political freedoms against the further encroachment of government.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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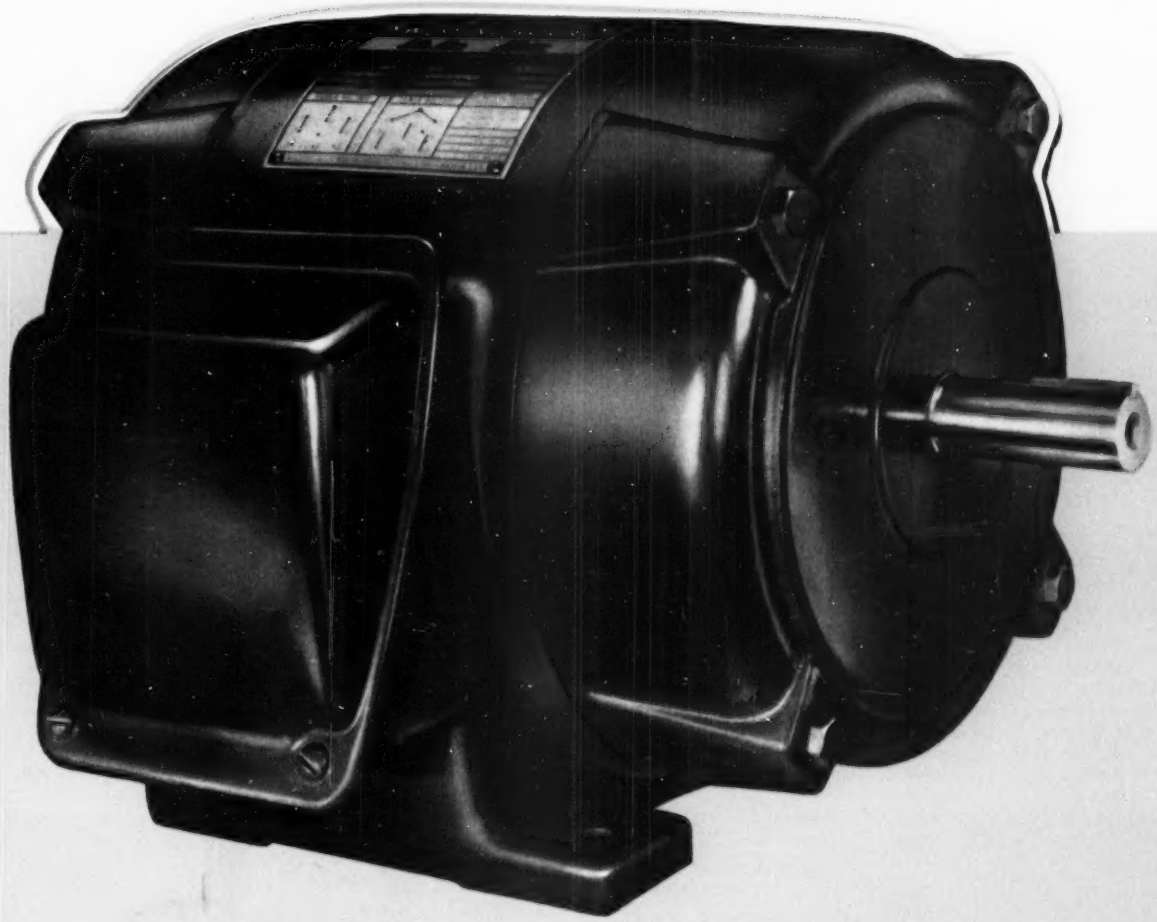
The new Life-Line A motor ...the big step ahead by Westinghouse



Here it is... the new Life-Line® "A" motor. A new motor that steps ahead to lead the industry. A new motor that reflects the continuing engineering and manufacturing leadership of Westinghouse. A new motor that gives you...

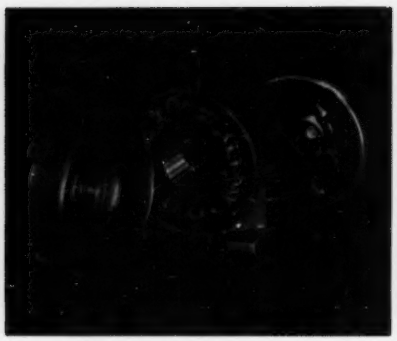
- Greater protection
- Greater application flexibility
- Smoother, quieter operation
- Lower maintenance costs
- Fewer motor outages
- Longer motor life

The new Life-Line "A" motor is still a step ahead of the industry. How? Through balanced design and proved performance. Look at the improved materials and advanced mechanical and electrical components—each one matched to its neighbor.

YOU CAN BE SURE...IF IT'S

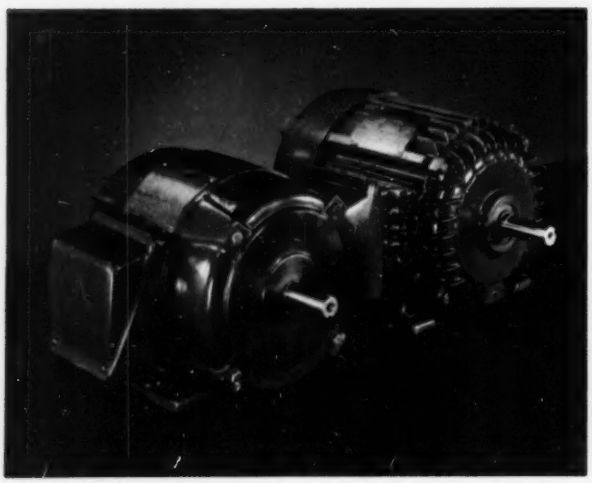
Westinghouse

New 4-WAY SEAL, pre-lubricated bearing . . . another step ahead. A bearing with *two* protective seals on *each side.* Inner seals form labyrinth joints. Outer seals act as flingers. This bearing has the advantages of the original Life-Line sealed bearing—*plus extra protection.*

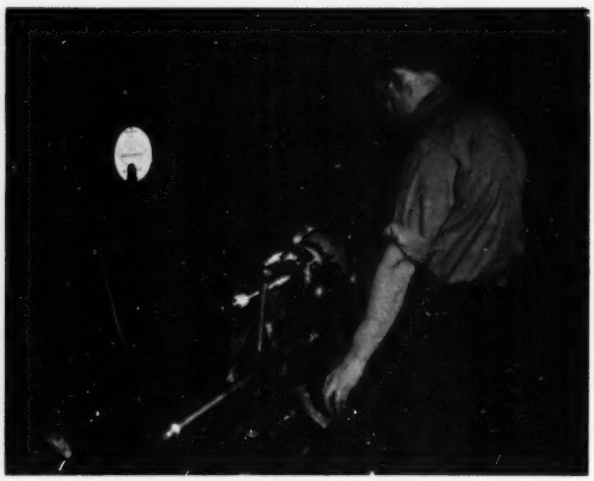


New FORTIFIED INSULATION . . . another step ahead. MYLAR*, a slot insulation with greater dielectric and mechanical strength. BONDAR, a wire insulation with more heat resistance. BONDITE, a stator insulation with greater strength to withstand destructive elements.

New PROTECTED HOUSING . . . another step ahead. Bracket openings are located in the under-quadrant for maximum protection. Brackets can be rotated for wall or ceiling mounting. Circumference of frame is *completely enclosed* so that it remains dripproof in *all* positions.



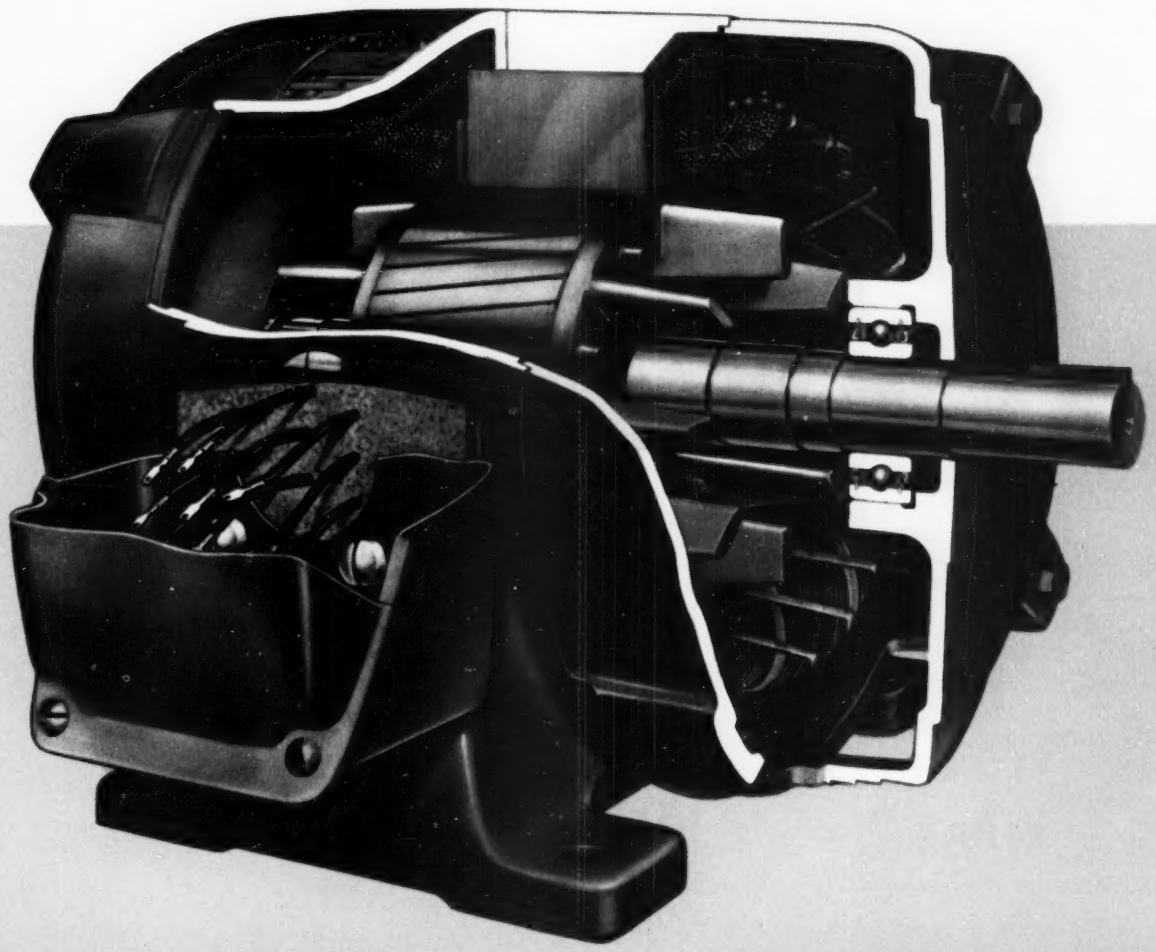
New ARMORIZED ENCLOSURE . . . another step ahead. The latest techniques in the casting art are utilized to fabricate more rugged housings that have greater application flexibility. Frame and ribbed feet are cast as a single unit for maximum rigidity. Wall sections are extra thick throughout.



New PRECISION MANUFACTURE . . . another step ahead. Each machining operation produces a new industry standard for concentricity. Improved rotor balance is attained through new precision tools. New rigid quality standards have been established for every component and the complete motor.

*Trademark for DuPont polyester film.

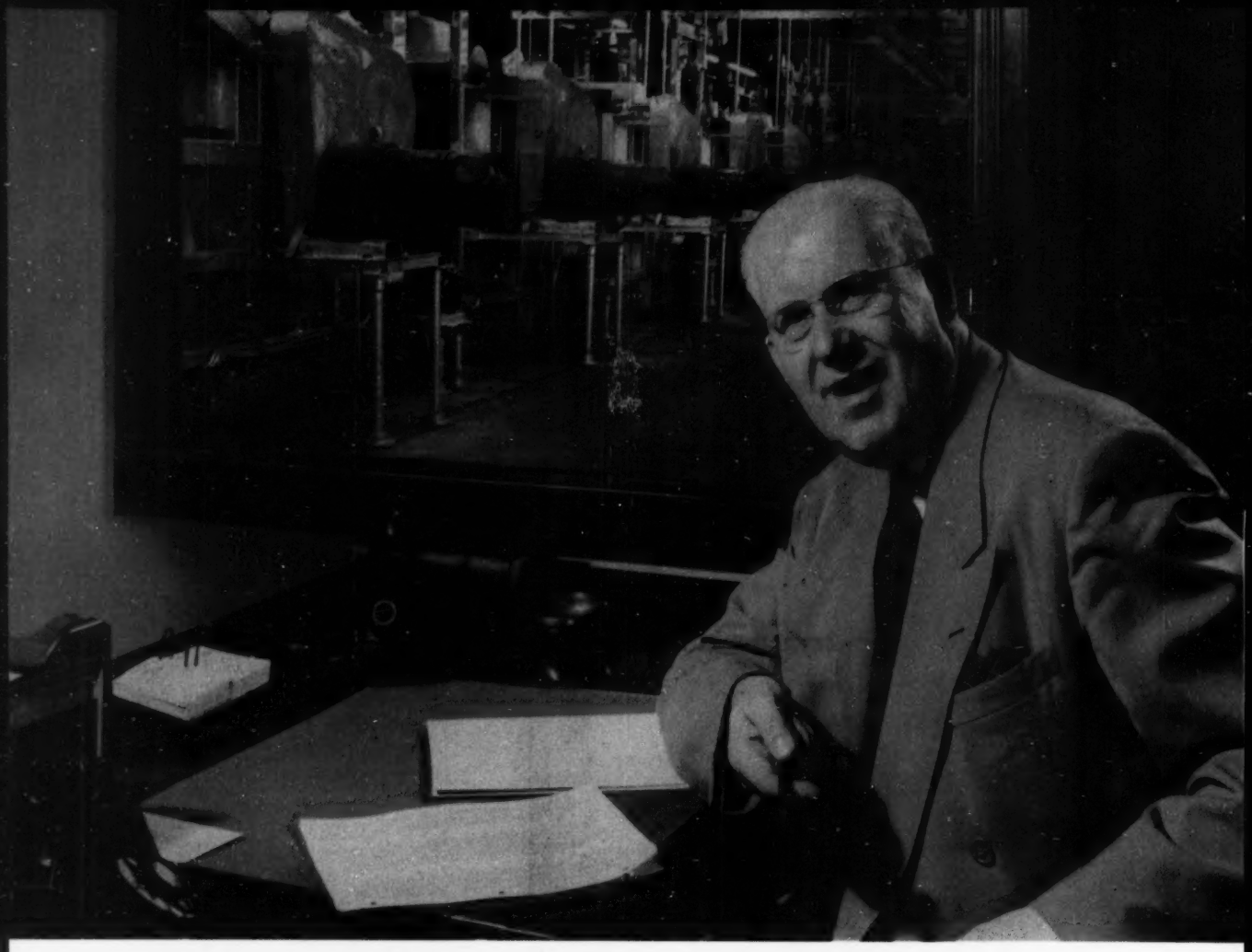
The new Life-Line A motor
...the big step ahead by Westinghouse



New? Yes, but not untried. The new Life-Line does not discard the past . . . it profits by it and builds upon it. Each component of the new Life-Line has been screened in the laboratory, then proved on production-line motors. You're not buying "theoretical" performance. The new Life-Line is a proved Life-Line.

GET THIS FREE BOOK

Here are all details on the new Life-Line "A" motor. Read about the new insulating materials—the new stator core—the new cooling methods—the new precision manufacturing techniques. Write for your copy of Booklet B-6154. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.



"We Simplified Ordering, Speeded Servicing When We Specified *Life-Line* Gearmotors"

"We ended round-robin chases to various suppliers whenever speed-reduction equipment is needed. By using Life-Line® Gearmotors we place only one call to one manufacturer . . . Westinghouse. Our ordering procedure has been greatly simplified, for no other supplier need be contacted to complete our speed-reduction package.

"For servicing, too, we know just where to turn. Every component of Life-Line Gearmotors is made and serviced by Westinghouse. We've learned through experience that *one* call to Westinghouse brings prompt and expert attention for our entire drive equipment. Down time has been reduced which means a real saving for us."

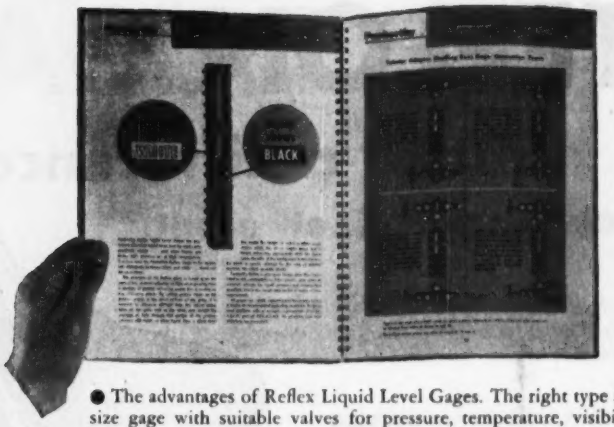
Life-Line Gearmotors Mean Westinghouse Service

Every Life-Line Gearmotor is backed by a nationwide service organization, a ready supply of gearmotor parts, complete repair facilities conveniently located and a staff of field engineers ready for consultation on any of your drive problems.

Your local Westinghouse representative will be glad to give you full details. Call him at any time or write: Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa. J-21840-B

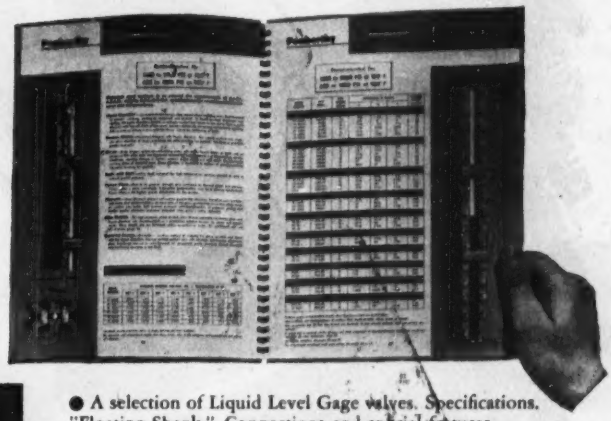
YOU CAN BE SURE... IF IT'S Westinghouse

FACTS AT YOUR FINGERTIPS



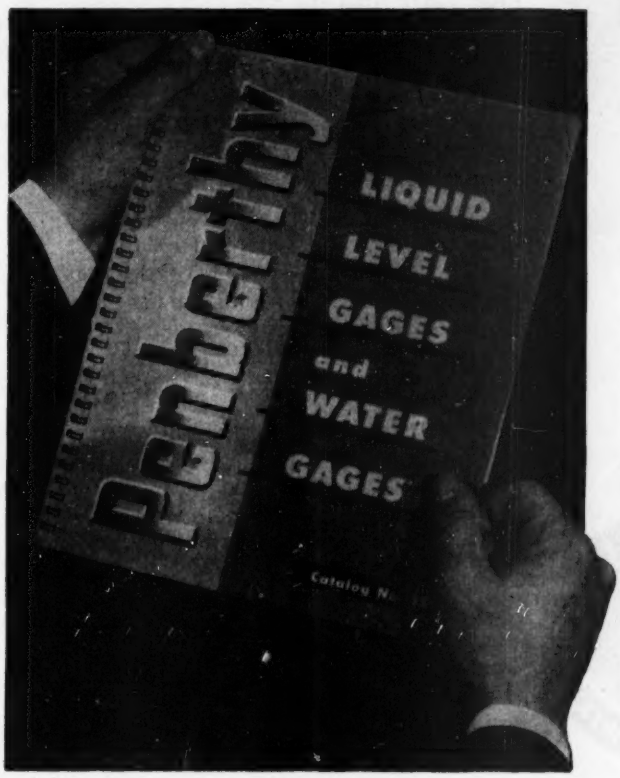
● The advantages of Reflex Liquid Level Gages. The right type and size gage with suitable valves for pressure, temperature, visibility range and valve centers. Multiple section gages. Drop Forged bodies. Pyrex glass. Basic and special designs.

● When to use Transparent Liquid Level Gage Sets. High pressure steam service. Adapters, valves, connections. Types available with recommendations.



● A selection of Liquid Level Gage valves. Specifications. "Floating Shank." Connections and special features.

● Metallurgical specifications. Gage glass and guard rods. Engineering service.



Penberthy's Catalog 35 is jam-packed with illustrated facts and specifications. It is your best guide to selecting the right liquid level gage sets at the most economical cost. In the complete Penberthy line, there are standard products for almost every application. Where your needs are special or unique, use the experience of almost 70 years to solve them. Take a tip from many thousands of satisfied users and write for your copy of Catalog 35.

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PENBERTHY INJECTOR COMPANY

Division of the Buffalo-Eclipse Corporation

1242 Holden Ave., Detroit 2, Michigan

There's *Certain* satisfaction in products by PENBERTHY

TEFLON GASKETS

make a difference in performance!

By equipping every a.c.f. Lubricated Plug Valve with the new Teflon Gasket, we have lengthened service life while improving operation.

You get greater protection against head leakage... trouble-free operation in temperatures up to 450° F. Greatly reduced turning torque.

What's more, this new gasket—tested in the field for four years under the most exacting conditions—is a discovery that can mean substantial savings in time and money. Investigate today! See your a.c.f. Representative for the complete facts.

Gasket characteristics:

- self lubricating
- can't bind
- unique shape maintains lubricant release
- pressure tight

Round Port Valves—100% Obstruction Free • Rectangular Port Valves with Full Pipe Area • Venturi Valves for Economy

a.c.f. CYLINDRICAL FULL PIPE AREA

Representatives in 50 Principal Cities

PLUG VALVES

Write for Catalog No. 4-CM and Price List. American Car and Foundry Company, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Michigan

How much extra do you think special design cost on these flexible connectors?

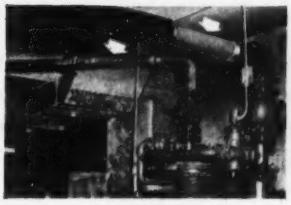
If you guessed one penny extra, you're wrong. "American" engineers designed these connectors, complete with special fittings, to meet specific requirements . . . *at no extra charge!*

American Flexible Metal Connectors answer thousands of problems in conveying steam, water, oil and other liquids, semisolids and gases. When planning new installations or starting a real money-saving effort to eliminate unsatisfactory connections—look first to American. *Special* design costs you nothing.

In working with flexible connectors over many years, American has made use of a variety of metals: Bronze, Brass, Aluminum, Steel, Stainless Steel—in a wide range of ID's—with end fittings adaptable to all types of connections. Let American's accumulated experience go to work for you.

64196

Here's the easy way to solve problems of . . .



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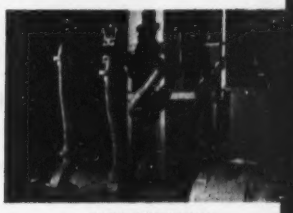
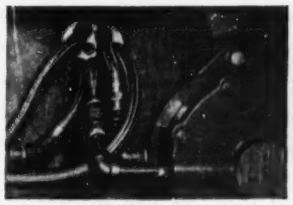
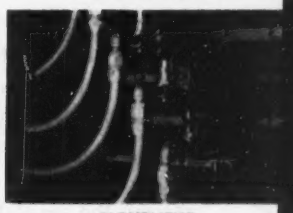


MISALIGNMENT



CRAMPED SPACES



MOVEMENT

WHEREVER CONNECTORS MUST MOVE

AMERICAN

flexible metal hose and tubing

an ANACONDA® product

The American Brass Company, American Metal Hose Branch
Waterbury 20, Connecticut.

Please send me Booklet CC-400 which shows how America Flexible Metal Hose and Tubing is designed, installed and use

NAME _____ TITLE _____
(Please Print)

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

ELEANOR THREW IN THE

Nice gal, Eleanor. Smart, conscientious, a good worker. Almost lost her a few months back though. And all because we were trying to improve our service to you readers. This is how it happened . . .

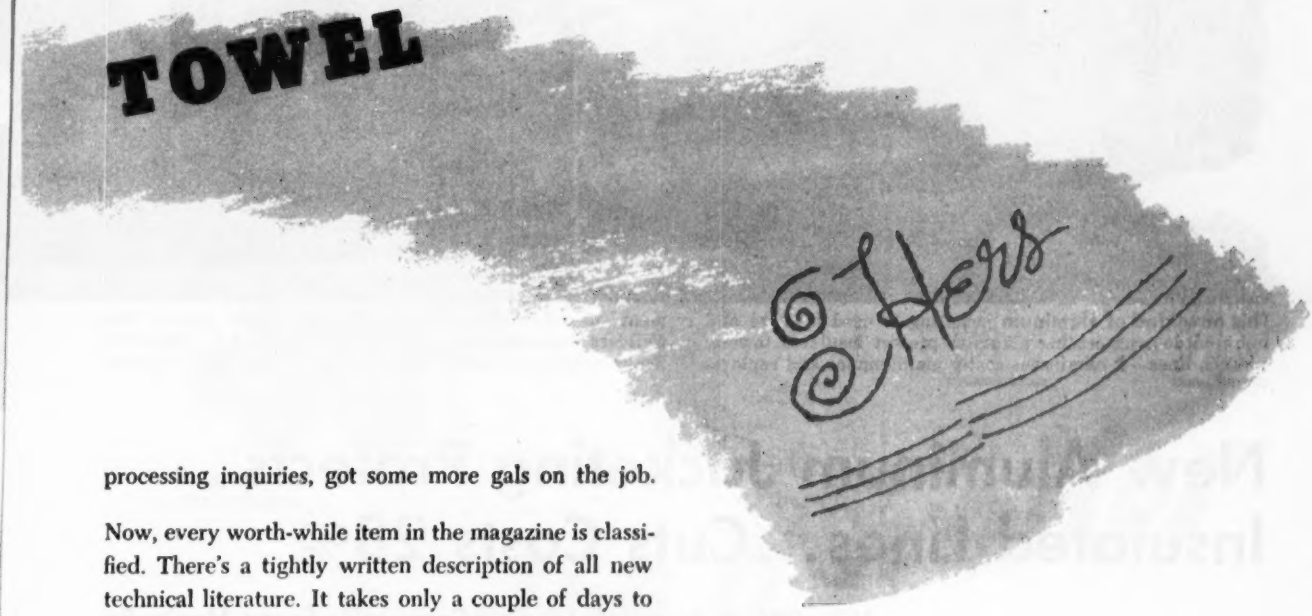
Eleanor had made herself invaluable around CE's Research Department – a regular Dream Girl Friday. She took shorthand, typed 80 words a minute, knocked herself out handling scads of requests for both readers and advertisers. In her spare time she did all the typing and clerical work on Reader Service.

Came the revolution! Some of you readers dropped us a line, made a few beefs about the service, said it took too long to get an inquiry answered, even made some suggestions about what we should do about it.

You should have seen Eleanor's face when we told her. She'd been so busy she had to take her Reader Service work home. Patient gal that she is, we hadn't heard a peep from her either. But this time it was too much. She said she'd had it, gathered up her extra lipsticks, umbrella and flat-heeled shoes and bailed out.

That really set us thinking. If you fellows weren't satisfied and a nice girl like Eleanor got mad enough to quit, something had to be done and fast. So we did it! We made a complete study of the whole operation, organized a brand-new Reader Service Department, revamped the format and streamlined the method of

more engineering-minded production men read it . . . more



processing inquiries, got some more gals on the job.

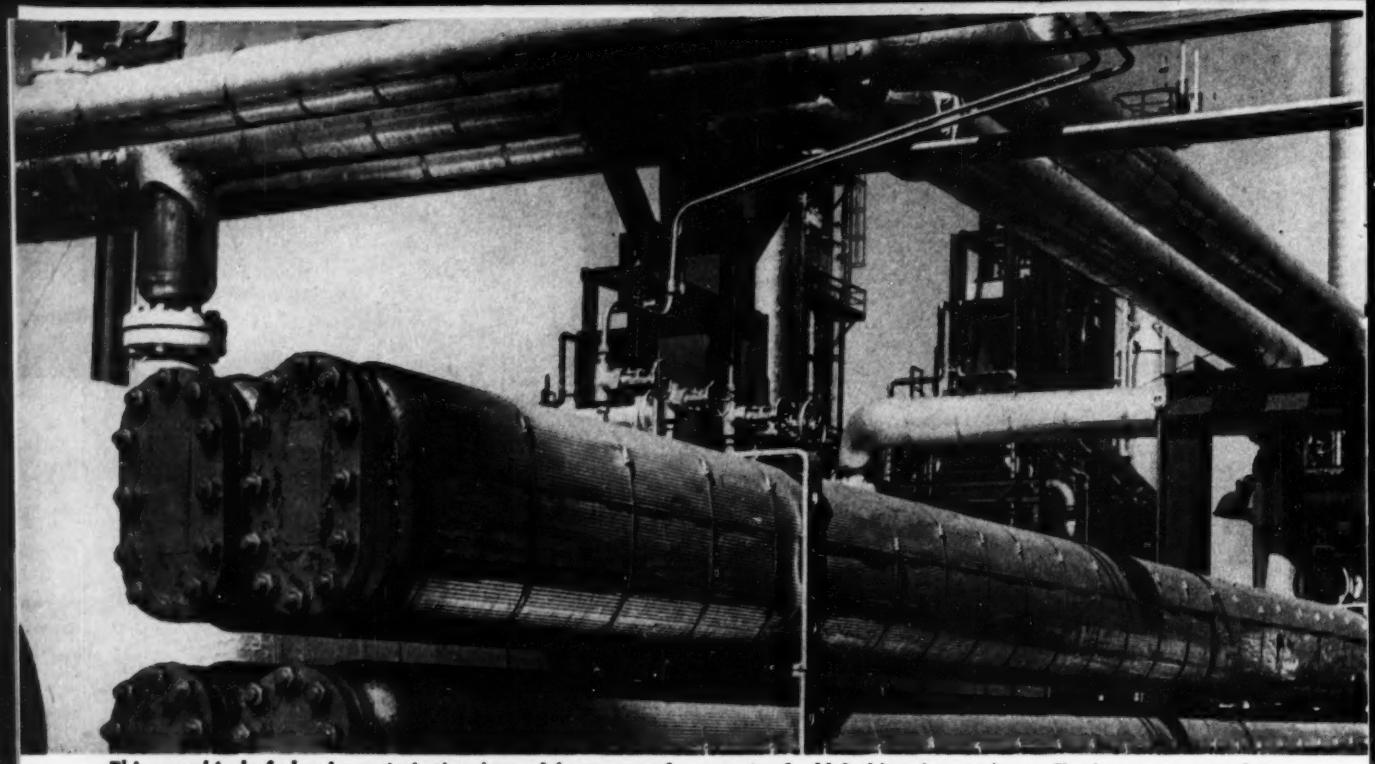
Now, every worth-while item in the magazine is classified. There's a tightly written description of all new technical literature. It takes only a couple of days to relay your request to the manufacturer, and if he handles it promptly, you've got your data back in a week or so. What's more, the reply card is postpaid and there's an extra one – in case you come back to your copy or an associate wants to use Reader Service.

So, if you haven't used Reader Service within the past few months, better give it a try. You'll find it a time-saving way of obtaining more information on products and services described in CHEMICAL ENGINEERING.

chemical engineers profit from it . . .

Chemical Engineering

A McGRAW-HILL PUBLICATION, 330 WEST 42nd STREET, NEW YORK 36, N.Y.



This new kind of aluminum jacketing is used in more and more outdoor processing plants to protect insulated towers, vessels, lines—it eliminates costly maintenance and replacement of old-fashioned coverings. Engineers report that Childers Jacketing has advantages not found in expensive heavy sheet aluminum, costs less to buy, far less to apply.

New Aluminum Jacketing Protects Insulated Lines...Cuts Costs 28%

How 986 of America's Leading Companies Saved Money By Weather-proofing Insulated Lines This New Way:

A two-man crew can apply the jacketing fastest. Only tools are a pair of pliers and a wedge or screw driver as shown here, Note how easily the jacketing forms around the pipe.

Aluminum strapping can be pulled plenty tight enough with just pliers like this. No special strapping tool needed. Strapping is pulled down between lugs and bent over.

Up-to-date appearance, low cost, and long life go hand in hand in a new aluminum jacketing for insulated lines. Developed by Childers Manufacturing Co., Houston, Texas, it is the first permanent weather-proofing that offers both low initial cost and low application cost.

Childers Jacketing, made of tough 3S aluminum alloy for maximum corrosion resistance, lasts years without painting or other maintenance. It costs less than even the cheapest kind of weather-proofing, when the cost of one paint job is considered. Savings run up to 28%.

Cost-minded engineers are also impressed with the gleaming beauty of Childers Jacketing that means "good plant housekeeping."

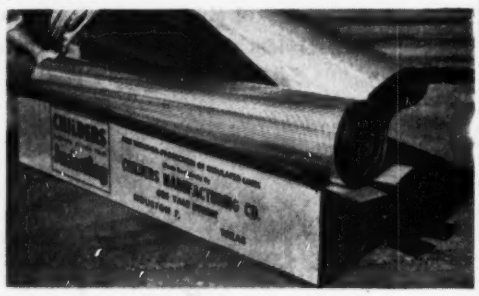
Available with moisture barrier attached, for use over 85% magnesia insulation.

5 years of tests and major installations in 986 of America's leading processing plants, refineries, and power plants have proven the advantages of Childers Aluminum Jacketing over other types.

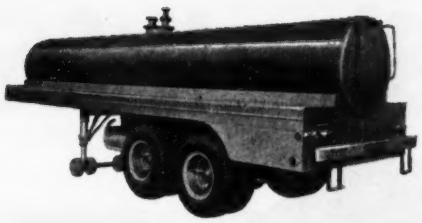
Try this low-cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation.

Address Childers Manufacturing Co., Dept. CE 8, 3620 W. 11th St., Houston 8, Texas.

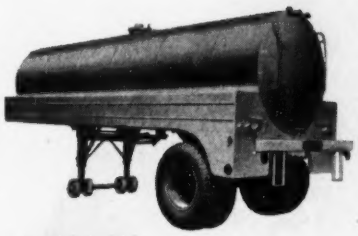
Engineering representatives in all principal cities to work with you on your problems.



This is how the flexible, easy-to-handle Childers Jacketing arrives at the job site. It is in convenient rolls 4 feet wide and 100 feet long—just right for one man to handle—and is available either with or without a moisture barrier attached on the back of the .006" aluminum "skin." It can be cut to proper lengths using any flat table and a straight-edge. (Advertisement)



SULPHURIC ACID
TANK-TRAILERS



LIQUID LATEX
TANK-TRAILERS

CAUSTIC SODA
TANK-TRAILERS

...OW LONG WILL IT STAND UP?

...s It Right For Your Job?

W... It Profit Your Business?

IS IT WORTH THE PRICE?

Judge a Trailer

BY ITS VALUE!

PRICE ALONE is no criterion when you're buying a Trailer. There are some bargains that aren't bargains at all, if you ask this question: "Does the Trailer have the exact specifications it *needs* to do my job?"

When you put a Fruehauf into service, you know it will stay there, hard at work — an asset to your business because of its *low* maintenance cost — because it is specifically engineered by the world's most experienced Tank-Trailer manufacturer to haul a certain type of liquid chemical. It has feature after feature to give you profitable, dependable hauling for many more years than you can ordinarily expect. Many of these Fruehauf features, such as the tire-saving Gravity Tandem Underconstruction, are exclusive—you can't get them elsewhere at any price.

Compare the specifications, as well as the prices, next time you buy a Trailer. Compare the *value,* to be sure you're getting your money's worth. You will always be sure of *full* value with a Fruehauf.

Fruehauf
TRAILERS
"ENGINEERED TRANSPORTATION"

World's Largest Builder of Truck-Trailers

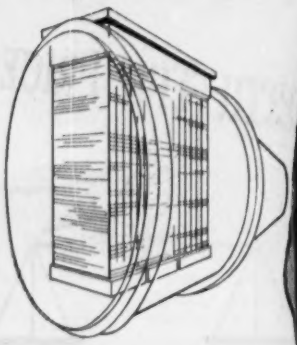
FRUEHAUF TRAILER COMPANY

Detroit 32, Michigan

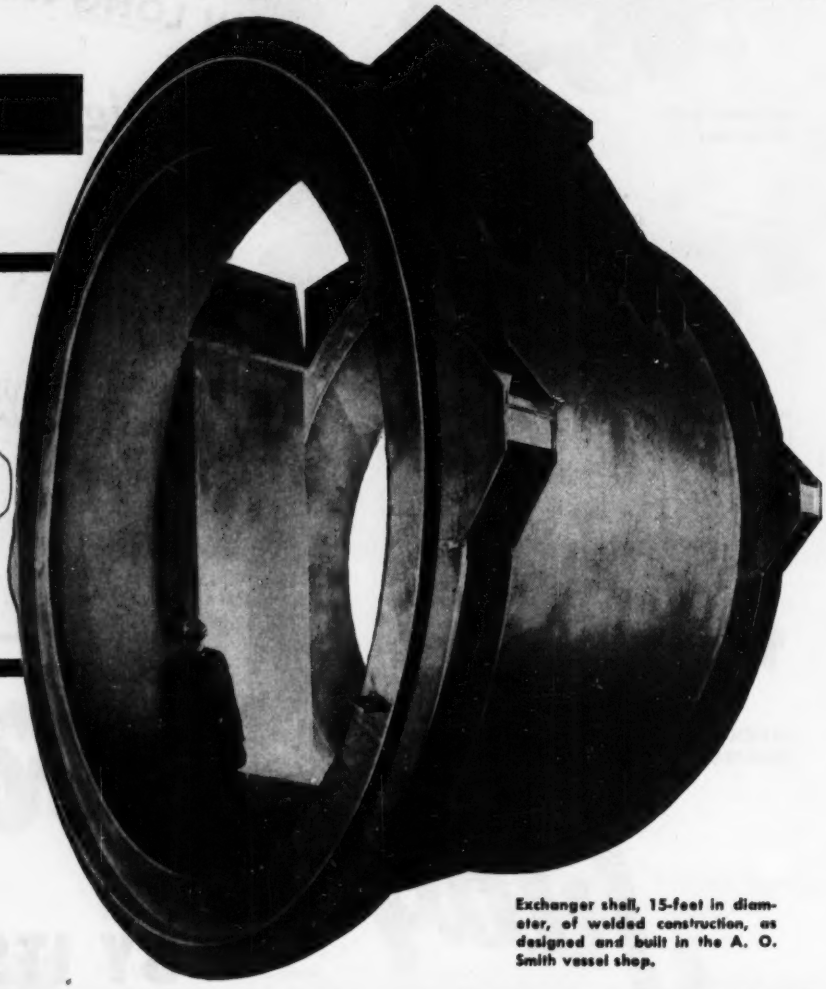
FOR ANY CHEMICAL HAULING JOB—THE BEST BUY IS A FRUEHAUF!

A.O.Smith for

VESSELS



Sketch shows general arrangement of assembled exchanger. Tube bundle is installed through rectangular opening in the top on which tube sheet rests.



Exchanger shell, 15-feet in diameter, of welded construction, as designed and built in the A. O. Smith vessel shop.

COOLER FOR GAS

A case history of A. O. Smith design, engineering and manufacturing skill

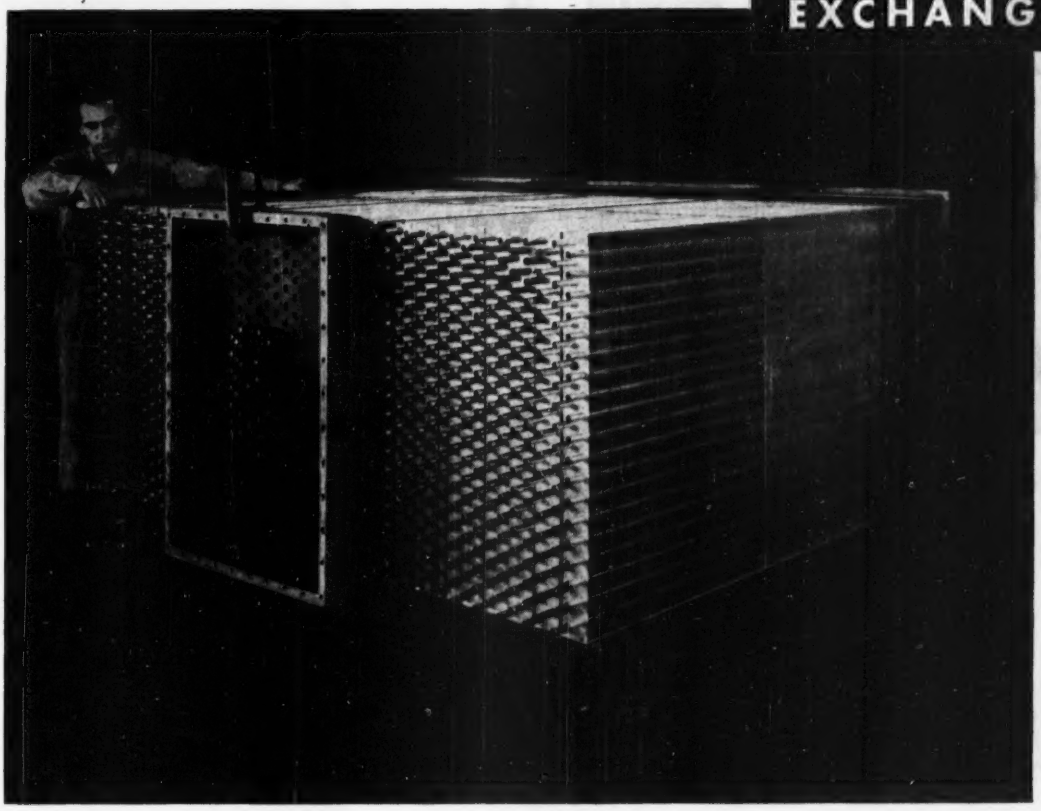
It required the combined pressure vessel and heat exchanger shops of A. O. Smith to produce this, and similar coolers, for the Gas Dynamics Facility of the Arnold Engineering Development Center at Tullahoma, Tennessee. They will cool air for a supersonic wind tunnel. Thermal capacity of this cooler is approximately 85,000,000 BTU/hr. It is designed for 140 psi on the water side, full vacuum on the air side, and to handle as much as 1,890,000 pounds of air per hour with inlet temperatures as high as 410° to 435° F.

The shell, above, is so big and tolerances so exacting that its construction required the services of a manufacturer with a proved record of diverse vesssel experience to fabricate it. It is a weldment, 15 feet in diameter. Yet, maximum out-of-round tolerance is but ¼ of wall thickness and the ends of the vessel are perpendicular to axis within −0° 10′. Clearance between baffles and the tube bundle, when installed, is held to 0.125 inch to prevent air by-pass.

Few manufacturers can take on the responsibility for such a vessel and at the same time provide the equally exacting tube bundle which it houses.

Outstanding Advantages

EXCHANGERS



Tube bundle for exchanger as designed and built in the A. O. Smith heat exchanger shop.

DYNAMICS FACILITY

The tube bundle, providing approximately 80,000 square feet of outside surface, is made up of ¾-inch tubes and aluminum fins spaced 12 to the inch, mechanically bonded to the tubes. Multiple floating heads, of A. O. Smith design, assure freedom from thermal stress, meet the extreme operating conditions in service and permit ready accessibility for replacement of a portion of the bundle or individual tubes.

This outstanding example of vessel and exchanger fabrication in one shop reveals the capacity of A. O. Smith Corporation to satisfy your most exacting pressure vessel and heat exchanger problems. Opportunities are invited to assist in planning, designing and fabricating complete vessels and thermal transfer units. Inquiries will receive prompt and expert attention.

For glass-lined process equipment, contact
GLASCOTE PRODUCTS, INC.
Cleveland 17, Ohio
A new A. O. Smith subsidiary

A.O.Smith
CORPORATION
MILWAUKEE HOUSTON LOS ANGELES
INTERNATIONAL DIVISION: Milwaukee 1, Wis.

if

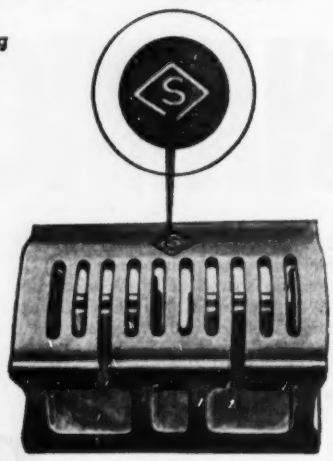
Michelangelo

were alive . . .

. . . he would probably consider the technical and metallurgical perfection of Sivyer castings as a work of art. A foundryman of no mean ability . . . he would be quick to recognize the craftsmanship of Sivyer methods . . . the know-how and precision with which a wide variety of complicated castings are produced. Sivyer insistence on the highest standards of compositional accuracy—uniformity of internal structure, dimensional accuracy and good finish means lower costs—better performance. It will pay you to consult Sivyer on your steel casting problems.

the HALLMARK of better steel castings

Sivyer castings are identified with the famous Ⓢ marking —your assurance of the finest in high alloy and specification steel castings.



SIVYER

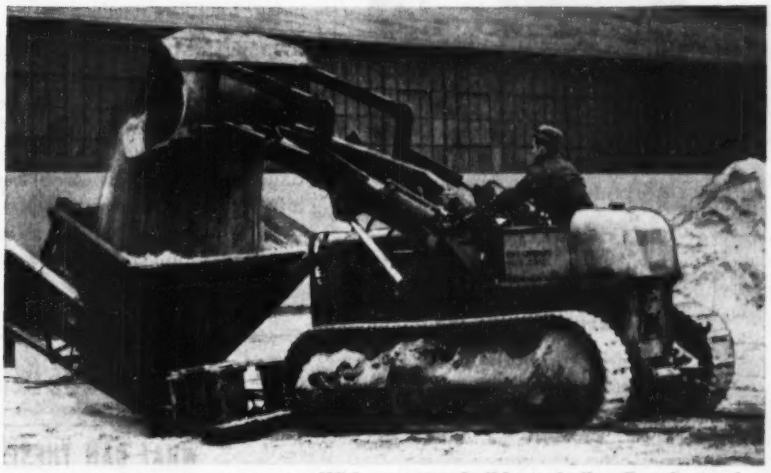
SPECIALISTS IN HIGH ALLOY AND SPECIFICATION STEEL CASTINGS

SIVYER STEEL CASTING COMPANY • MILWAUKEE Ⓢ CHICAGO Ⓢ

New Materials-Handling Technique Features Tractor Shovel with Quick-Change Front End

Equipment flexibility is an important answer to high production costs. This accounts for the popularity of the thousands of Allis-Chalmers HD-5G Tractor Shovels now in use in plants of all kinds. The 40-hp. crawler, with its wide range of front-end attachments, digs, carries, dumps, stockpiles, spreads or loads materials of all kinds. Its power and versatility enable it to replace a fleet of part-time specialists . . . to pay its way *full time* both in and around the plant.

DIGS TRENCHES — With Trench Hoe attachment, the HD-5G digs a flat-bottom ditch 27 in. wide and to a depth of 8 ft. Ideal for laying pipe, digging foundation footings, other vertical excavations.



HANDLES SAND, CLAY — ANY BULK With standard 1-yd. bucket, the HD-5G loads trucks, feeds hoppers and conveyers, builds stockpiles. Crawler tracks stand up in cullet and other abrasive material as only steel can.

SKIDS, LOADS, STACKS SOLIDS — Lift Fork attachment handles steel beams, pipe, lumber, packaged or palletized loads up to 4,000 lb. Works easily in unpaved yards where rubber-tired equipment bogs down.

OTHER attachments include Narrow Bucket, Rock Bucket, Rock Fork, Tine Fork, Crane Hook and Drag Bucket. Attachments may be interchanged in about 20 minutes by simply removing and replacing four pins. Ask your Allis-Chalmers dealer to show you how the versatile HD-5G can increase efficiency in and around your plant.

SPEEDS YARD MAINTENANCE AND NEW CONSTRUCTION — Bulldozer or Angledozer blades quickly clear or level land for new construction, backfill trenches and foundations, maintain unpaved yard roads.

CLEARS SNOW — Big 2-yd. Light Materials Bucket quickly cleans up and loads snow from yard roads and parking lots. Also doubles output in coal, coke, cinders and other light materials.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

for your information...

brief summaries of helpful product news

Photo and data courtesy Associated Sales & Supply Co.

Chloro-IPC Kills Weeds, Saves Growers' Money

Weed-free condition of the field shown in the photograph is the result of using Monsanto Chloro-IPC.

Applied to a field of seventy-day, second-crop green onions at the rate of two pounds per acre, Chloro-IPC saved users approximately $75 per acre as compared with hand weeding.

Results like these are helping to rapidly increase the market for Chloro-IPC. This selective herbicide can be applied in a wide variety of soils and climatic conditions to control weeds. It has already proved its worth in cotton and soybean fields, in spinach and other vegetable crops.

Chloro-IPC gets effective results by acting through the soil to kill germinating weed seeds. It can be made as a wettable powder or emulsifiable concentrate and is easy to apply by ground spraying equipment. For more information mail the coupon today.

Actamer Cuts Resident Skin Bacteria Up to 97%

Hand cleanliness is important in many industries. This is particularly true in bakeries. It has been indicated that much of the spoilage in bakery products is caused by hand-borne rather than airborne microorganisms.

Actamer,* Monsanto's bacteriostat, is ideal for use in hand soaps to reduce resident skin flora. Because Actamer clings stubbornly to the skin, repeated use keeps hands virtually germ-free long after washing and reduces resident skin bacteria up to 97%. For more information mail the coupon.

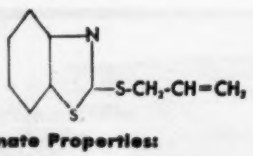
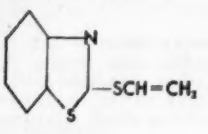
Monsanto Cyclohexylamine Economical Organic Base

Need a strong organic base which is economical to use? Try Monsanto cyclohexylamine. This clear, nearly colorless liquid has a pH value of 10.5 in an aqueous solution of 100 ppm. It also forms salts with all acids including long-chain fatty acids.

Cyclohexylamine has an extremely high affinity for carbon dioxide and rapidly absorbs it from the air. This compound is also very reactive because of its nitrogen component. It is a strong, economical organic base and, in general, enters into all of the typical amine reactions. One or both hydrogen atoms attached to the nitrogen may be replaced by various functional groups.

Research Chemist's Corner

WHAT CAN THESE COMPOUNDS DO FOR YOU?

	2-(ALLYLTHIO)BENZOTHIAZOLE	2-(VINYLTHIO)BENZOTHIAZOLE
Synonym:	2-(Allylmercapto)Benzothiazole	Vinyl Mercaptobenzothiazole
Formula:		
Approximate Properties:		
Mol. Wt.	207	193
Appearance and Color:	Amber-colored oil	Orange liquid
Assay:		95—98%
Odor:	Mild Mercaptan	Mild Mercaptan
Solubility:	Very soluble in acetone, ether, alcohol, ethyl acetate, benzene, heptane and chloroform.	Soluble in benzene, ethanol, ether; insoluble in water.
Stability:	Stable	Polymerizes
Brief statement of chemical properties:	Reactive olefinic double bond, slightly basic nitrogen atom.	Reactive olefinic double bond, slightly basic nitrogen atom.
Melting Point:	−2° C.	*Boiling Point:* 107—109° at 0.2—0.3 mm.

Cyclohexylamine is used as a dyestuff intermediate, petroleum additive, component in boiler water treatment, corrosion inhibitor, and in organic syntheses. To get a technical bulletin on this compound, mail the coupon.

New Monsanto Tank Truck

Faster service for Monsanto benzyl chloride customers in on the way, thanks to a new nickel tank truck to deliver shipments.

The new truck will also simplify handling problems. Unloading is accomplished by nitrogen pressure—customers need only hook up an unloading line as no pump is required.

Facts on the Flow of Slurries For the Cement Industry

Reprints of a new article entitled "Facts for the Cement Industry on Flow of Slurries" are available from Monsanto.

Recently published in the trade press, this article by Dr. John R. Van Wazer gives a thorough and detailed discussion of all the key factors involved in the flow of cement slurries.

Dr. Van Wazer, in the first part of his paper, briefly reviews the basic facts about the different classifications of materials which flow: normal or Newtonian fluids, plastic or Bingham fluids, pseudoplastic fluids, and dilatant fluids. Several consistency curves are given for these kind of fluids.

Following this review, Dr. Van Wazer describes the flow of cement slurries and gives an explanation of the mechanism of deflocculation. He concludes that the addition of a deflocculant, such as sodium tripolyphosphate, to a raw cement slurry has several important results. The water content of the slurry can be considerably reduced, milling improved, and the character of flow changed from the plastic to the dilatant type.

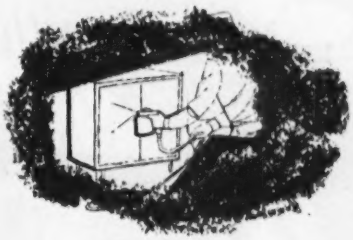
Single-Source Buying For Detergent Industry

Both anionic and nonionic wetting agents and a complete line of detergent phosphates can be obtained from one source—Monsanto. Anionic Santomerses,* nonionic Steroxes* and phosphates, all come from the world's largest producer.

"One-stop" ordering of these products can give you faster service and greater economies.

Moreover, you can depend on the outstanding performance of these compounds. Sterox AJ, for example, has many important advantages. It possesses a faint, pleasing odor. It is chemically inert, stable and active over a wide range of conditions. This unusual stability coupled with superior surface-active properties makes Sterox AJ valuable in numerous applications.

Uses include laundering, paper rewetting, industrial cleaning compounds, detergent sanitizers and textile processing. Write for bulletin P-147.



New Flatting Agent Developed by Monsanto

There's a superior Santocel* now . . . *Santocel Fifty-Four*.

The new product is a greatly improved flatting agent for lacquer manufacturers. Developed by Monsanto research, Santocel Fifty-Four has these important advantages over other flatting materials:

- Settles much less in the vehicle
- Requires little or no grinding
- Does not reduce flatting efficiency if overground
- Disaggregates more readily
- Provides smoother films.

Write for more information today.

*Reg. U. S. Pat. Off.

MONSANTO CHEMICALS – PLASTICS

MONSANTO CHEMICAL COMPANY 3/54
1703 South Second Street, St. Louis 4, Missouri

Please send information on:

- ☐ Santocel Fifty-Four
- ☐ 2- (Allylthio)Benzothiazole
- ☐ 2- (Vinylthio)Benzothiazole

Please send:

- ☐ Reprint of "Flow of Slurries" article
- ☐ Sterox AJ Bulletin P-147
- ☐ Chloro-IPC data sheet
- ☐ Actamer technical bulletin
- ☐ Cyclohexylamine technical bulletin
- ☐ 2- (Allylthio)Benzothiazole sample
- ☐ 2- (Vinylthio)Benzothiazole sample

Name..... Title.....

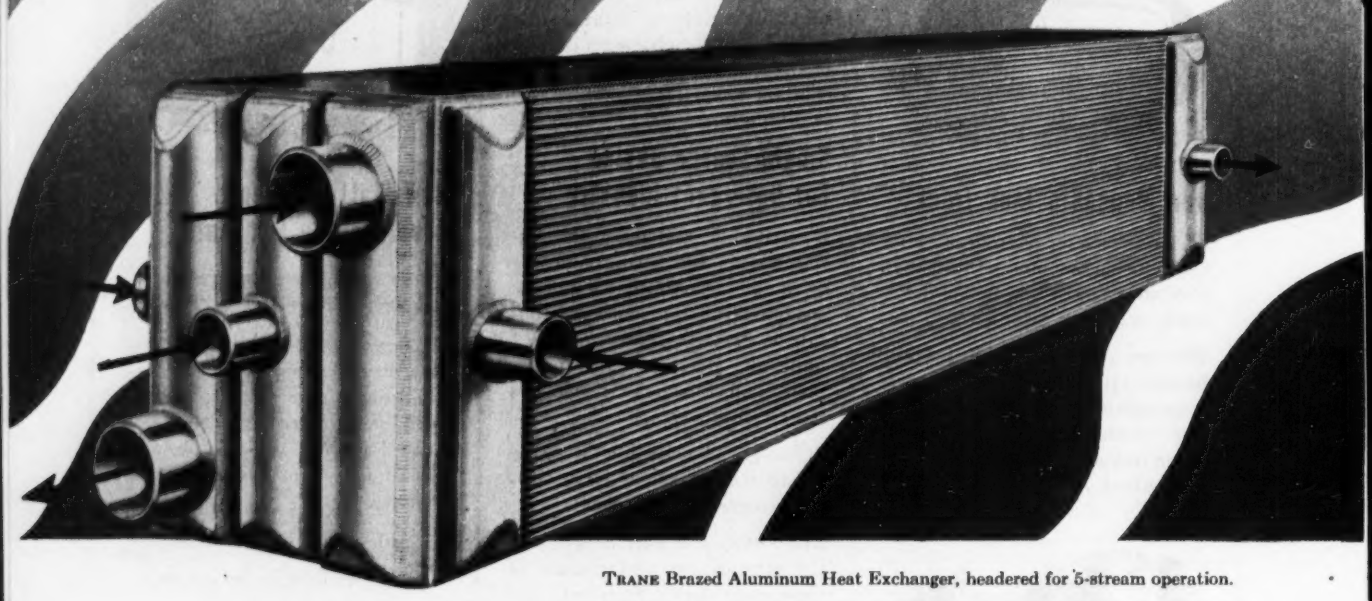
Company.....

Street.....

City..... Zone..... State.....

5 passes... 5 gases...

with just one Trane heat exchanger



TRANE Brazed Aluminum Heat Exchanger, headered for 5-stream operation.

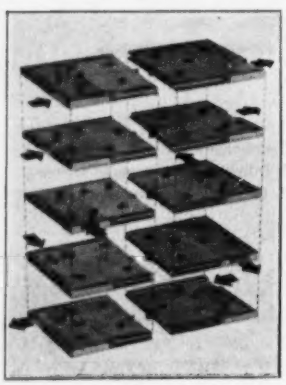
Multi-fluid heat exchanger for large scale process heat transfer saves space, saves cost

The problem of heat transfer between three, four, five or more liquids or gases in process operation can be solved by lighter, more compact, more economical TRANE Brazed Aluminum Heat Exchangers. One multiple-stream TRANE unit has in many instances occupied ⅓ the space at ¼ the weight of conventional heat exchangers, at far less cost . . . making it particularly well suited for processes using multi-stream heat transfer, such as air separation, helium and ethylene recovery. The reason . . .

More efficient heat exchange surface of TRANE brazed aluminum gives you a lighter weight heat exchanger that packs up to 450 sq. ft. of heat transfer surface into one cubic foot, yet operates at pressures up to 500 psig with temperatures as low as —350° F.

Whether your heat exchange problem involves close temperature approach, low temperatures or multi-fluid heat transfer, there is a TRANE Brazed Aluminum Heat Exchanger to fit your needs. Our 30 years' experience in all phases of heat transfer plus our laboratory facilities provide the solution to these problems.

For further information, ask your TRANE Sales Office for a copy of "Extended Surface Heat Transfer Equipment" or write TRANE, La Crosse, Wisconsin.



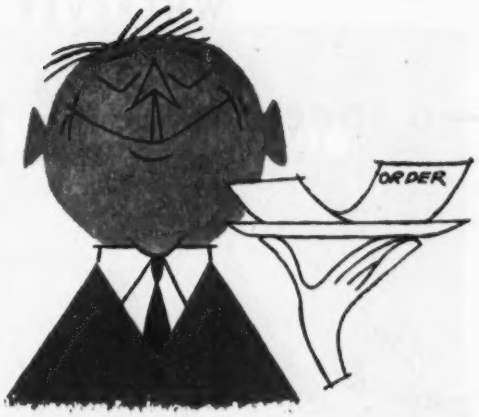
This symbolic drawing shows how one TRANE Brazed Aluminum Heat Exchanger can handle as many as five fluids simultaneously. Compact design simplifies headering. Units are available for cross-flow and counter-flow operation.

TRANE *brazed aluminum heat transfer surfaces*

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 87 U.S. and 14 Canadian Offices.

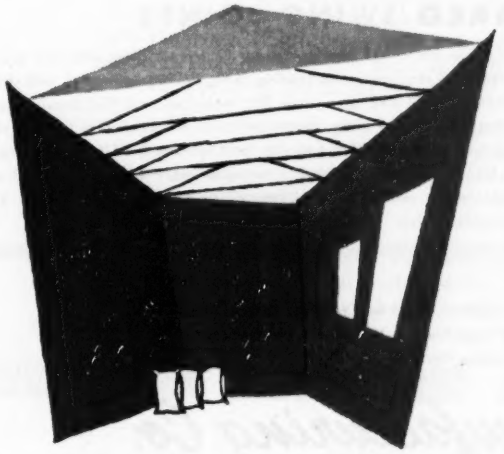
Your order for Kaiser Alumina...



gets fast individual attention...

assuring immediate delivery...

often overnight, in emergencies...



thus reduces large, costly inventories.

This personal service—combined with unsurpassed quality and experienced technical assistance—has made Kaiser Chemicals a major supplier of calcined and hydrated aluminas. Today, we supply alumina to more than eighty per cent of the nation's users.

Whether you manufacture abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, we have the product and the service to meet your needs exactly. Contact principal sales offices: Chemical Division, Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California; First National Tower, Akron 8, Ohio.

Kaiser Chemicals

calcined and hydrated aluminas

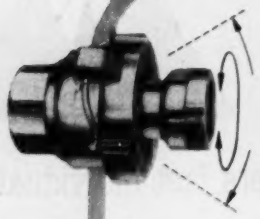
Alumina • Basic Refractory Bricks and Ramming Materials • Dolomite Magnesia • Magnesite • Periclase

See our complete listing in Chemical Materials Catalog

WHEREVER PIPING MUST MOVE

—a specialized BARCO flexible joint!

for angular motion—

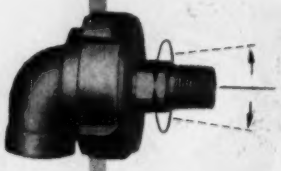


— also swivel motion

—BARCO BALL JOINTS

"One joint does the work of two or more!"—because it moves in any direction. Standard the world over where low cost, leakproof movable joints are needed in piping handling steam, air, water, oil, gas, or chemicals. Many models available. Up to 40° side flexibility *plus* 360° swivel action. Also used to facilitate quick connection of piping, overcome misalignment. Pressures to 7,500 psi; temperatures to 1,000°F. 15 different sizes, ¼" to 12". *Ask for Catalog No. 215.*

for swivel motion—



— also limited angular motion

—BARCO SWIVEL JOINTS

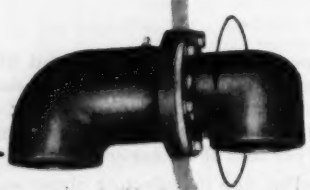
Self-aligning! Exclusive side flexibility (up to 10°) speeds up and facilitates installation; prevents binding. Widely used for making compact, low torque swivel connections to reciprocating or rotating parts on platen presses, tire molds, die casting machines, oil burners. Easy to position piping accurately—no sagging, flopping lines. Leakproof, safe—pressure or vacuum. Ratings as high as 600°F., 3,000 psi (hydraulic). Sizes, ⅜" to 2"; angle or straight. *Catalog No. 265*

for continuous rotation—

—BARCO REVOLVING JOINTS

Superior design insures trouble-free performance, minimum roll drag, and up to 50% power savings. Inherent low torque is little affected by increasing pressure, speed, or temperature. Parts are easily accessible. Light running action minimizes wear, permits free-floating installations. No adjusting necessary—long, leakproof service. Ratings to 250 psi (steam); 450°F. Single flow or syphon styles. Sizes ½" to 2" and special to 5". Wide choice of models. *For detailed information, ask for Catalog No. 300.*

for swing motion—



—BARCO SWING JOINTS

Barco's new line of ball bearing Swing Joints is complete with sizes and styles to meet every requirement on loading racks, fueling assemblies, and chemical applications. "O" ring gives long life, leakproof seal. Full bearing surface, swiveling 360° in one plane (single swing) or in two planes (double swing), supports normal piping. Ball bearings can't fall out. Built in steel for pressures to as high as 1500 psi (hydraulic); temperatures, —40° to 225°F. 11 styles: straight, angle, double angle, counter balance. Sizes 2", 2½", 3", 4". *Catalog No. 400.*

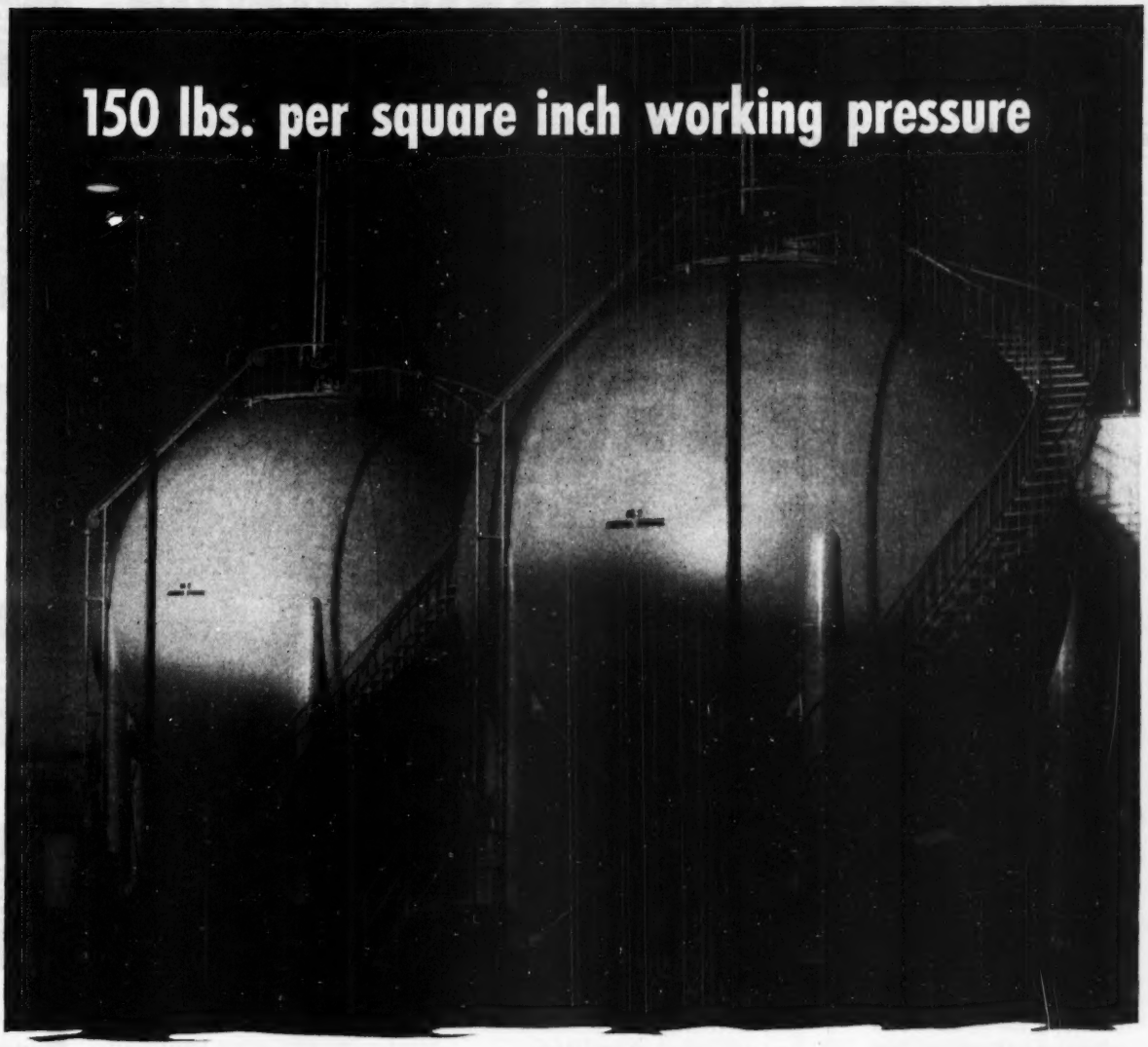
HIGH PRESSURE HYDRAULIC SWIVEL JOINTS—In addition to the four types of flexible joints illustrated above, Barco produces a complete line of High Pressure Hydraulic Swivel Joints for use with small diameter tubing or pipe. *Send for Catalog No. 269.*

BARCO *Manufacturing Co.*

516E Hough St., Barrington, Illinois (A Chicago Suburb) ***In Canada: The Holden Co., Ltd.***

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

150 lbs. per square inch working pressure



The two 2,320-bbl. Hortonspheres® shown above are used to store anhydrous ammonia at the Shell Chemical Corporation's Shell Point Plant near Pittsburg, California. Only a part of the plant's storage, these are two of four Hortonspheres of the same capacity. Designed for 150 lbs. per sq. in. working pressure, the tanks are 29.2 ft. in diameter.

The Hortonsphere is the ideal shape for the storage of volatile liquids and gases under pressure. When subjected to uniform internal pressure, the spherical shell is equally stressed in all directions tangential to the shell. It operates on the principle that a vessel will permit neither filling or breathing losses provided no air enters or vapor escapes.

Hortonspheres are built in capacities up to 30,000 bbls. for the storage of volatile liquids. Further information, estimates or quotations may be obtained by writing our nearest office.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2120 Healey Bldg.
Birmingham 1.....1510 North Fiftieth St.
Boston 10.....1005-201 Devonshire St.
Chicago 4.....2124 McCormick Bldg.
Cleveland 15.....2220 Midland Bldg.
Detroit 26.....1503 Lafayette Bldg.
Houston 2.....2103 C & I Bldg.
Los Angeles 17.1505 General Petroleum Bldg.
New York 6.....3318—165 Broadway Bldg.
Philadelphia 3.1625—1700 Walnut St. Bldg.
Pittsburgh 19.....3205 Alcoa Bldg.
San Francisco 4.....1522—200 Bush St.
Salt Lake City 4..505 West 17th South St.
Seattle 1.....1305 Henry Bldg.
Tulsa 3.....1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY — APRIL 1954

EXCHANGER DESIGNED FOR HIGH PRESSURE DIFFERENTIAL

A pressure differential of approximately 1300 pounds per square inch across the tube sheet is one of the unusual conditions to be provided for in a carbon dioxide condenser currently under construction in Kellogg's fabrication shops for a leading chemical processor.

The condenser consists of two shells, 18 inches in diameter, of forged integral channel fixed tube sheet construction. The tubes, 250 per bundle, are of ¾-inch admiralty, 20 feet long. The shell cover, channel, and tube sheets are all of steel.

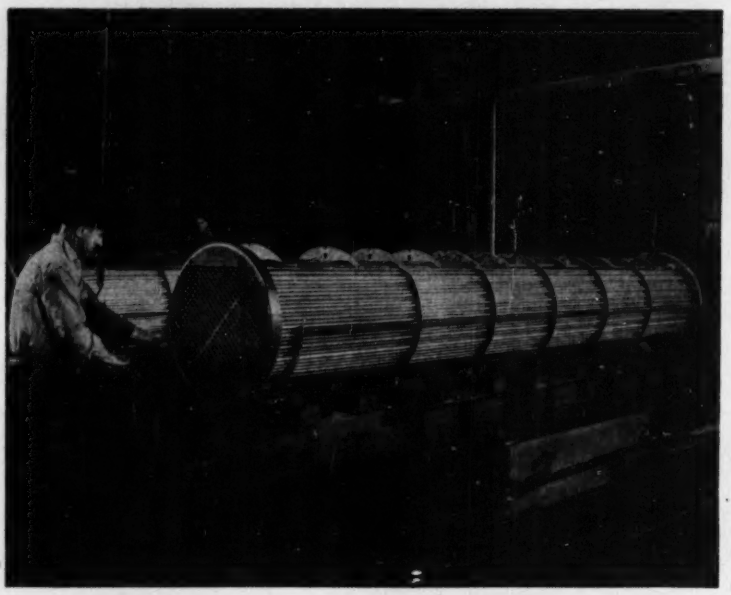
In operation, water will circulate in the tubes at a design pressure of 80 psig. to condense approximately 30,000 lbs. per hour of carbon dioxide under a pressure of 1400 psig.

Just one of scores of exchangers, condensers, coolers, and reboilers that annually come out of its shops, this job illustrates one of an infinite number of extreme conditions Kellogg is experienced and equipped to meet in designing and fabricating process equipment.

FABRICATED PRODUCTS DIVISION

M. W. KELLOGG

PULLMAN



Fourteen Shells for Three Condensers to Have Interchangeable Bundles

Three condensers currently being engineered by Kellogg for a major refiner will represent an optimum in interchangeability of bundles—a feature every refiner wants but one that is often difficult to achieve in a unit without over-engineering it.

The three condenser units, designed to handle C-4 cuts, comprise a total of 14 shells. Following normal design practices, initial Kellogg engineering proposals included three sizes of shells. However, further study by Kellogg engineers proved, in this instance, that it would be most economical in the long run to design the entire group of 14 shells for interchangeable bundles. Both proposals were submitted, the customer agreeing that the interchangeable bundle plan best served their purposes.

Each of the 14 sections are of floating tube sheet construction with 2040 square feet of ¾-inch admiralty tubes, naval brass tube sheets, and steel baffles. Inside diameter of each shell is 33 inches. The sections are all designed for 500 degrees F. on the shell side, 300 degrees F. on the tube side, and 300 psig. on one side.

Interchangeable bundles for this many sections will offer several important advantages to the refiner. They will, for example, cut down considerably on refinery maintenance stock, since only one *spare* bundle need be kept in stock to service any one of the 14 sections. Shorter down time for repairs are also expected to result from the fact that the spare bundle can be substituted easily in an emergency without shutting the unit down for lengthy repairs or rebuilding.

. . . An Exact Bevel

One of the two reflux reboiler shells being fabricated in Kellogg's Jersey City shop for a major petroleum refiner. Here a nozzle is being welded to the shell—the final operation that demands the utmost in precision. Holes for these nozzles have been cut with an exact bevel so that a perfect joint results when welding is completed.

EXCHANGERS

THIN WALL ALLOY PIPING

CLAD STEEL VESSELS

CONDENSERS

FRACTIONATING TOWERS

PRESSURE PIPING

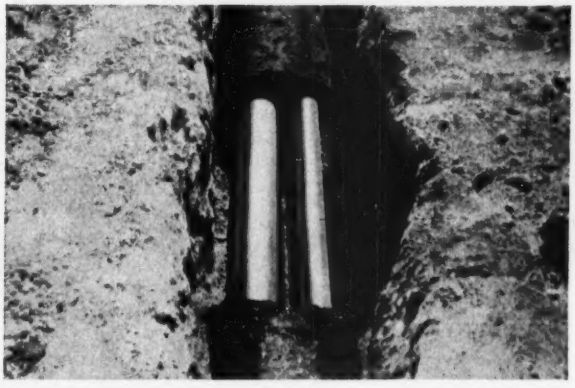
DIGESTORS

COOLERS

3 Big Reasons Why

1. GILSULATE—Easy to install—Just pour it on, tamp it down and backfill. Run heat through the pipes (up to 520°F)...and the job is completed. No need to remove rocks from backfill; no problems of cramped space or multiple piping.

more and more hot underground pipe gets insulated



2. GILSULATE—Cost Less per Installed Linear Foot—No skilled labor needed...requires no mechanical sheaths, special protective devices, or costly installation procedures.

with new modern triple-zone GILSULATE®

ZONE 1 Dense, semi-plastic coating bonded tightly to pipe surface. This Zone is waterproof and a thermal and electrical insulator.
ZONE 2 Sintered zone provides excellent thermal insulation under wet or dry conditions. Zone 2 is also waterproof.
ZONE 3 Unconsolidated GILSULATE particles provide excellent thermal insulation and a high load carrying capacity.
PIPE WALL

3. GILSULATE—Delivers Permanent Triple-Zone Protection—Three tough, massive circular sheaths completely and permanently protect the pipe, cut heat loss down to 8% to 11% of bare buried pipe. Triple-zone protects against all buried line corrosion conditions: water, roots, acid, alkalis, bacteria, etc.

Fill in coupon for complete details.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES

AMERICAN GILSONITE COMPANY, SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corporation and Standard Oil Company of California
Distributors in principal cities of United States and Canada

American Gilsonite Company
134 West Broadway
Salt Lake City, Utah

Please send me further information on GILSULATE

NAME .....

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CE

DARCO Digest

DARCO DEPARTMENT • ATLAS POWDER COMPANY
Darco General Sales Offices—60 EAST 42nd STREET, NEW YORK 17, N. Y.
ATLAS POWDER COMPANY, CANADA LTD., BRANTFORD, CANADA

DARCO Treatment Decolorizes Sulfa Drugs

Mainly for reasons of added customer acceptance, traces of color must be removed from the various members of the sulfa drug family. These materials, because of their solubility characteristics, have to be processed in strongly alkaline solution. In many other applications of adsorption by carbon, the presence of high alkalinity reduces adsorption efficiency.

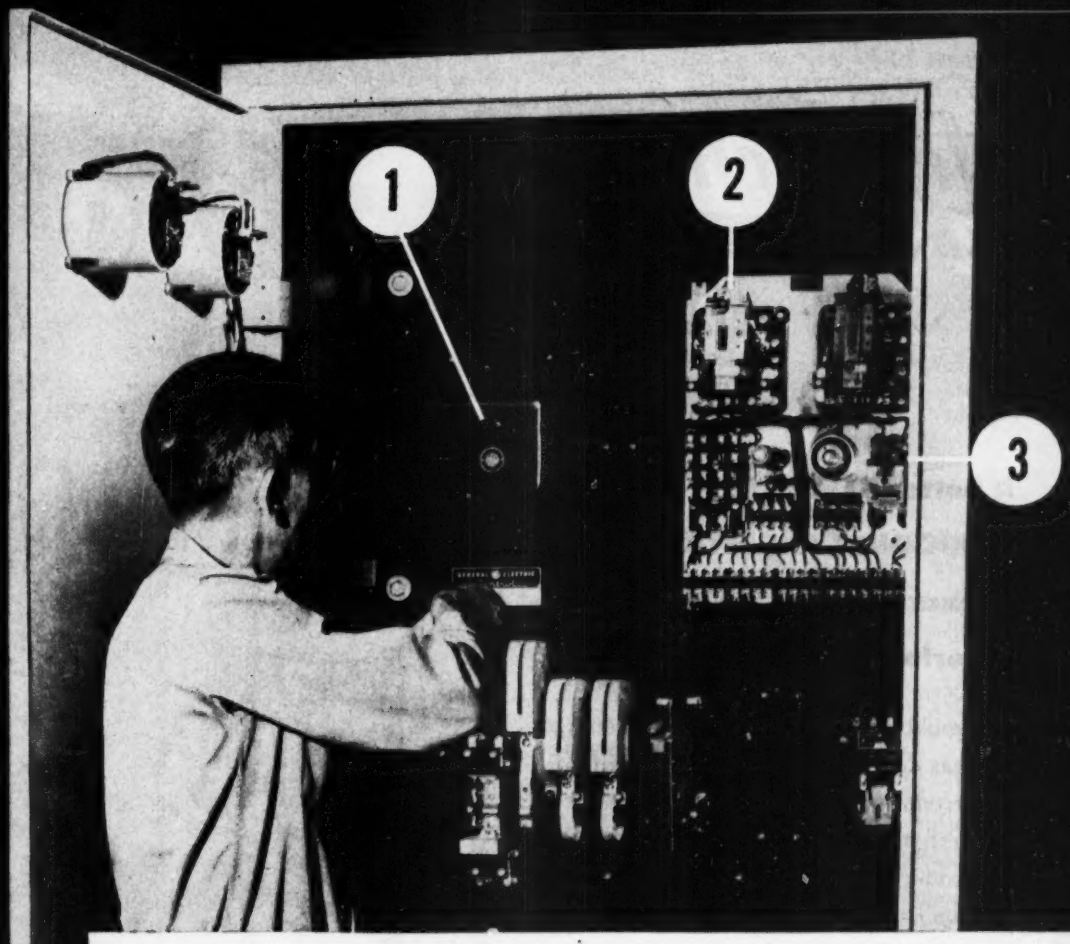
Selection of the right grade of Darco helps solve the problem. Darco G-60 does a thorough job of decolorizing the sulfa solution. In this case the high purity of Darco G-60 is particularly important: the hot, alkaline solution in which the treatment is conducted has a strong solvent action for silica, but none is extracted from Darco G-60 to contaminate the product.

Subversive elements "jailed" in DARCO

In its usual role as a purifying agent, Darco activated carbon is added to a solution, adsorbs the impurities, and then is filtered out —taking the undesirable constituents with it. Another interesting class of applications for Darco has developed recently, however, in which the carbon remains in the treated product. Its function is to pick up and hold an undesirable ingredient, "freezing" it in place and thus taking it out of action as a potential troublemaker.

A typical example of this use for Darco is the preparation of cements for oil wells. The muds used in drilling of the well hole often contain addition agents that improve the action of the mud but interfere with the setting of cement. The excessively long setting times which result can be substantially reduced by introducing small percentages of Darco into the cement. The Darco evidently inactivates the additives in the mud by adsorbing them and thus permits normal setting time.

If you have a problem of this general type, Darco specialists will be glad to offer technical recommendations.



Only G.E. Gives You These 3 Features in Standard Synchronous Motor Control at No Extra Cost

1. GRADUATED SQUIRREL-CAGE PROTECTION Relay protects motor during stall or subsynchronous operation. Protects squirrel-cage winding against overheating.

2. PRECISION ANGLE SWITCHING Field application relay takes fullest advantage of motor's synchronizing ability—applies field at correct speed and most favorable angle between rotor and stator poles.

3. LOAD ANGLE FIELD REMOVAL Fastest field removal available assures long motor life. Power-factor relay removes field within first half slip cycle out of synchronization.

You get these and other big features in ***standard*** G-E synchronous motor control at no extra cost. Be sure to get complete details—contact your nearest G-E Apparatus Sales Office or use the convenient coupon to get our new 16-page desciptive bulletin.

Section C 780-3
General Electric Company
Schenectady, N. Y.

Please send me your new bulletin, GEA-5873 which gives complete information on G-E Synchronous Motor Control.

Name.....
Position.....
Company.....
Address.....
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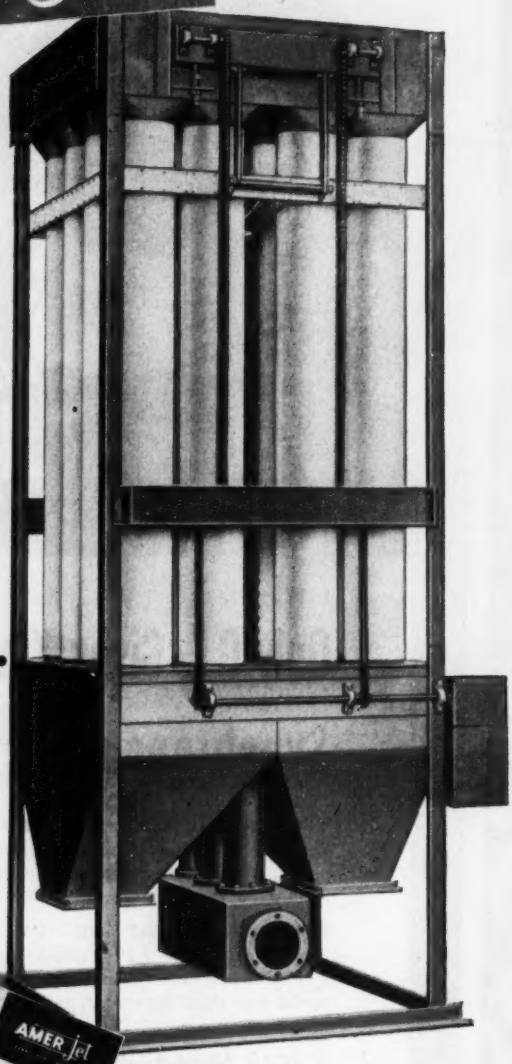
GENERAL ELECTRIC

Introducing AMER Jet



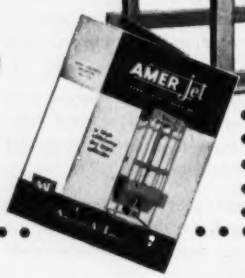
A better REVERSE JET TYPE FABRIC DUST ARRESTER built to exacting AAF design and performance standards

Just what you'd expect from the leader! American Air Filter has developed and field tested a fabric-type dust arrester incorporating the same basic concept and design features found in all AAF Dust Control Products, namely—*small space requirements; maintained performance over a wide range of operating conditions; constant exhaust volume; high collection efficiency.*

With these proven advantages established, AAF engineers then "iced the cake" with these additional features to further increase AMERjet's over-all efficiency—

- **Tension control to compensate for variation in fabric dimensions due to humidity changes.**
- **Rugged, foolproof mechanism for dislodging collected material with high pressure jets.**
- **Venturi-shaped inlet for dust-laden air extends life of cloth by greatly reducing the abrading effect.**

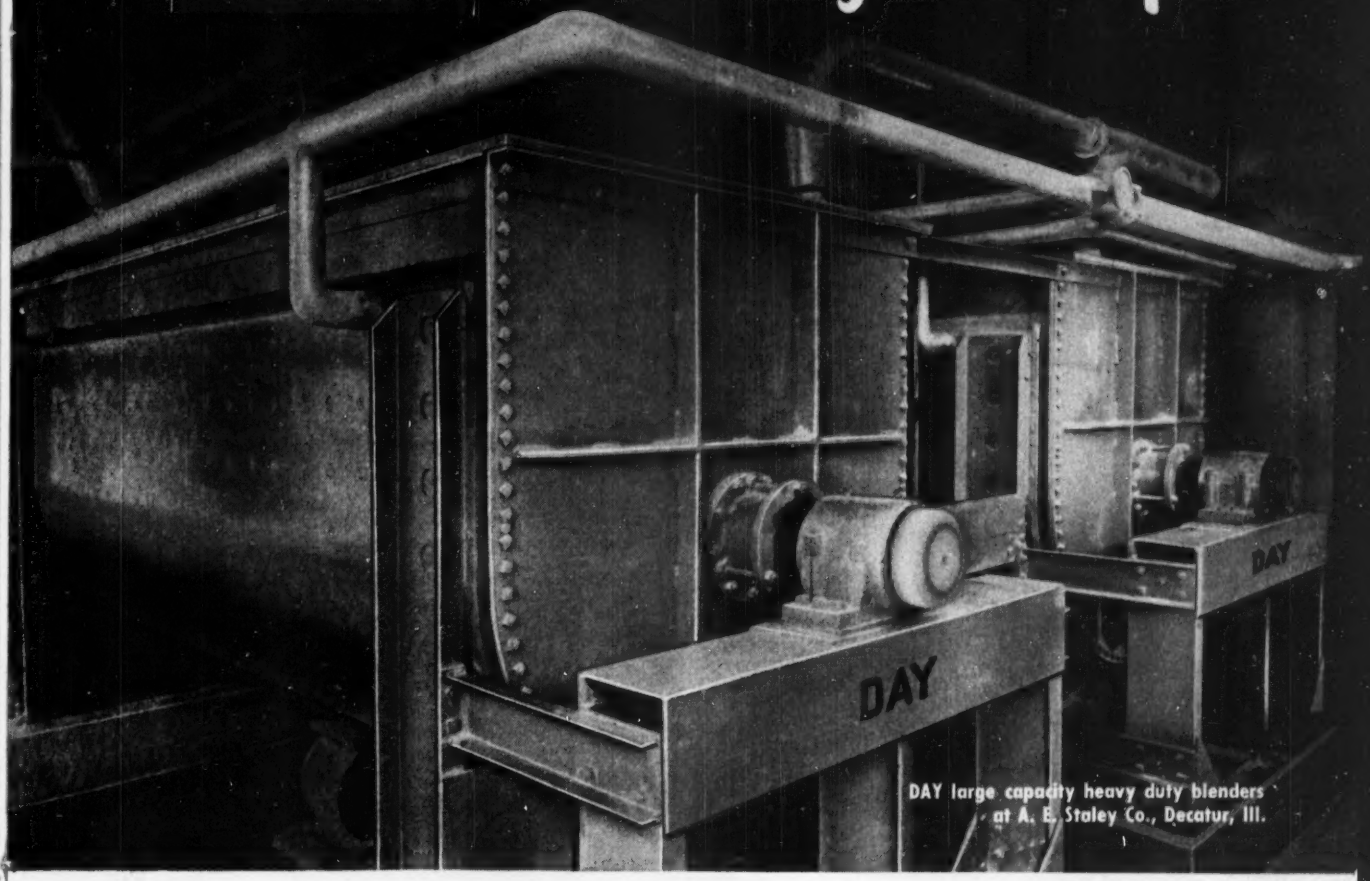
AMERjet is available for handling any exhaust volume.



For complete information on this new dry-type dust collector, call your local AAF representative or write direct for Bulletin No. 279.

American Air Filter
COMPANY, INC.
326 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

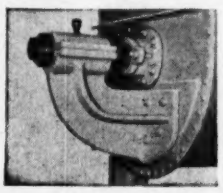
DAY means longer life span



DAY large capacity heavy duty blenders at A. E. Staley Co., Decatur, Ill.

Rugged construction plus precision engineering . . . that's the DAY combination that means *extra* years of trouble-free, economical operation. Plant after plant is finding this true. Whatever your special need, you'll find a DAY Heavy Duty Blender designed for you. Special DAY features on this Heavy Duty Blender have been developed to provide top performance and extra-long equipment life span. The DAY dry color agitator is designed for heavy bodied powders. Other types of agitators are available to meet specific requirements. DAY large outboard bearing construction gives maximum shaft support, smooth operation. Exclusive stuffing box design prevents bearing damage from abrasive materials, and eliminates danger of product contamination by bearing lubricants. The DAY spiral ribbon agitator is designed for paste, semi-paste, granular or liquid products. For complete information or service, call your nearest J. H. Day field engineer or write for Bulletin 354-A.

DRY COLOR AGITATOR



OUTBOARD BEARINGS

SPIRAL RIBBON AGITATOR

FOUNDED 1887

when you buy **DAY** *you buy dependability*

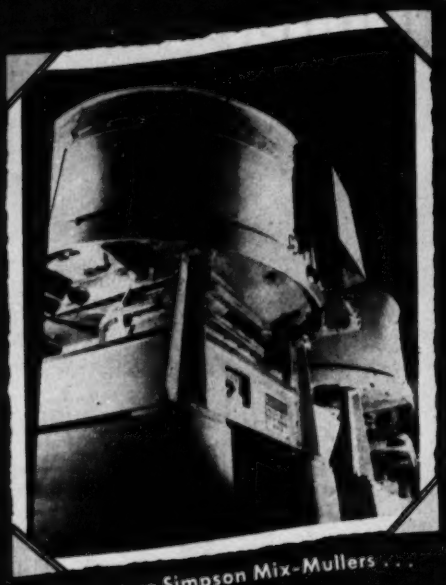
THE J. H. DAY COMPANY

INCORPORATED

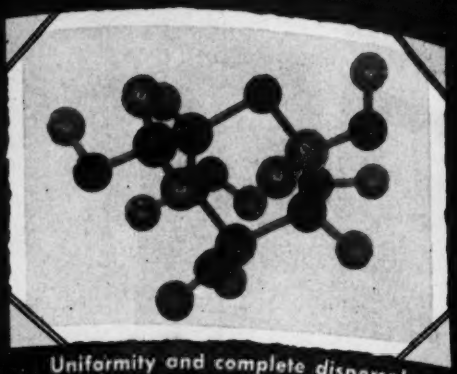
1147 HARRISON AVENUE • CINCINNATI 22, OHIO

PRODUCERS OF QUALITY EQUIPMENT FOR BAKING • PAINT & VARNISH • CHEMICAL FOOD • RUBBER • PHARMACEUTICAL • COSMETICS • PAPER & PULP • EXPLOSIVES CERAMICS • CANDY • SOAP • SUGAR • MILK PRODUCTS • OTHER MAJOR INDUSTRIES

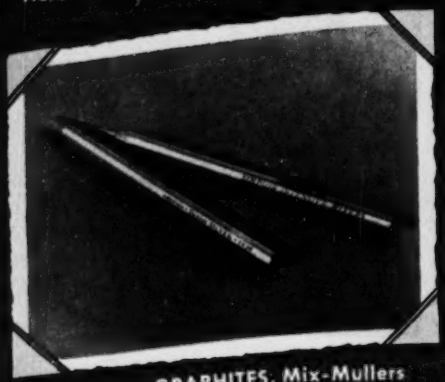
Yesterday's mixing



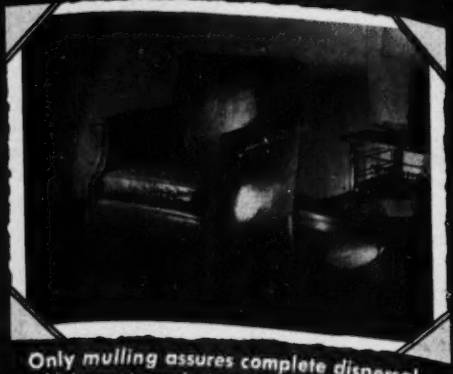
Here are two Simpson Mix-Mullers . . .



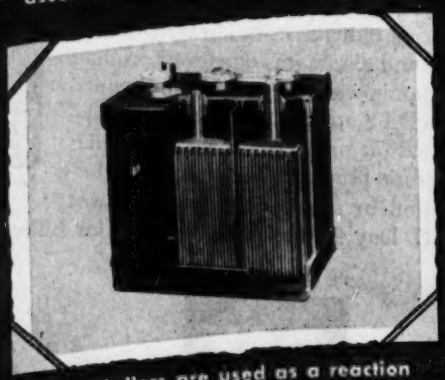
Uniformity and complete dispersal of elements is a necessity when mixing CATALYSTS.



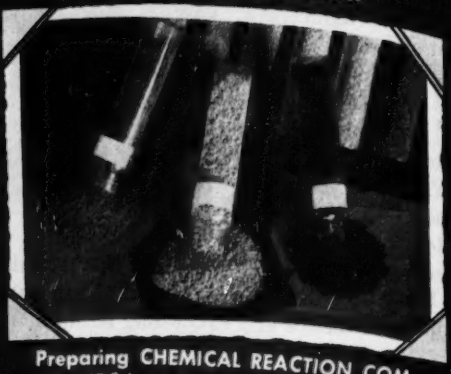
In mixing GRAPHITES, Mix-Mullers assure uniformity and absence of grit.



Only *mulling* assures complete dispersal of pigments and plasticizers so necessary for calendared PLASTIC items.

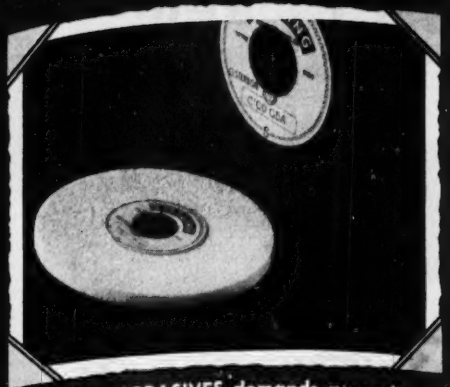


Mix-Mullers are used as a reaction vessel in preparing BATTERY PASTE.



Preparing CHEMICAL REACTION COMPOUNDS is an intricate process requiring very intimate blending.

problems... an album of experience with Simpson Mix-Mullers!



Mixing ABRASIVES demands rugged, long wearing mixers.

Simpson Mix-Mullers easily perform the difficult job of blending VITAMINS with BULK FEED.

A free, personalized mixing analysis in our laboratory will prove what a Simpson Mix-Muller will do on YOUR PRODUCT . . . write for details.

SIMPSON MIX-MULLER® DIVISION

National Engineering Company

604 Machinery Hall Building
CHICAGO 6, ILLINOIS

HERE'S A PAGE OUT OF OUR SCRAPBOOK OF SIMPSON MULLED PRODUCTS . . .

The feed manufacturer was wasting expensive vitamin concentrates through improper dispersal of a small amount of concentrate into a large amount of feed.

The battery producer needed a mixer that would handle corrosive acids safely.

The plastics producer was troubled with improper pigment dispersal.

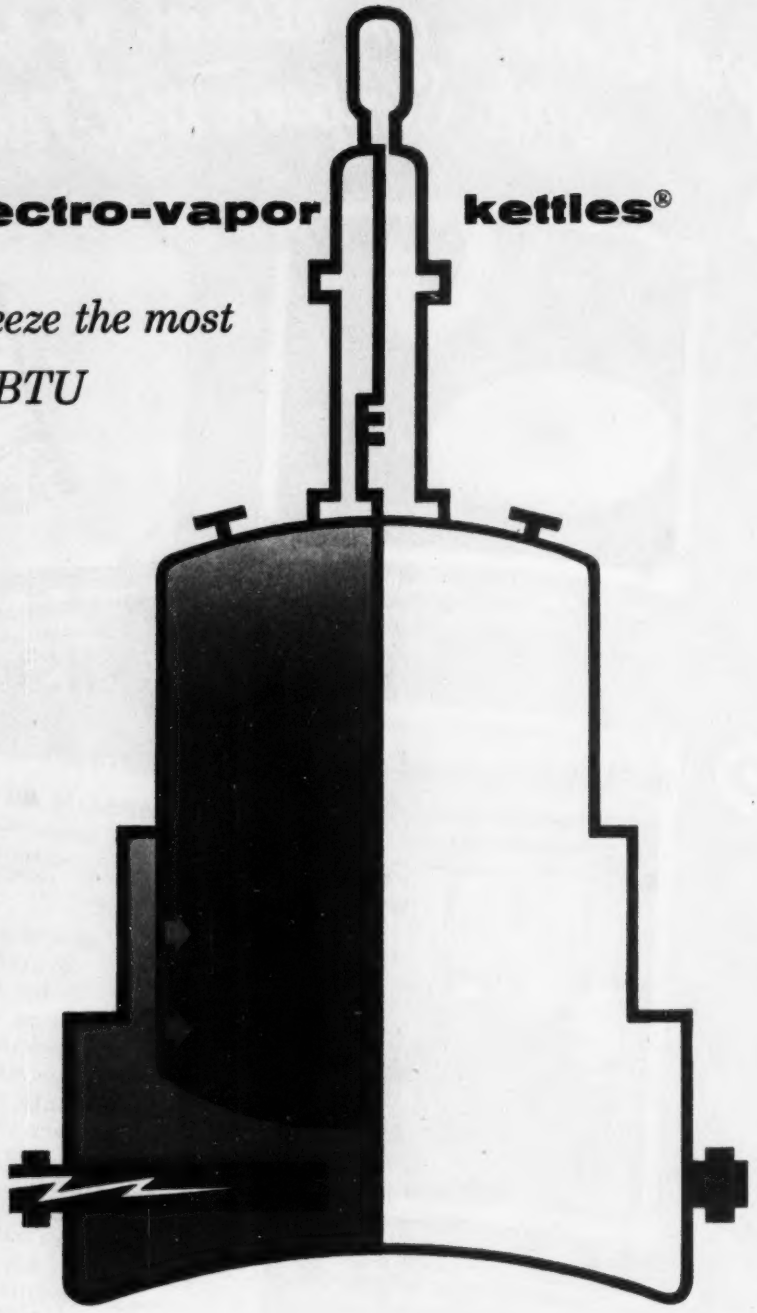
These are but a few of the many problems solved . . . the many products mixed in Simpson Mix-Mullers. YOUR mixing problem may involve different materials . . . or you may not even recognize it as a mixing difficulty. Whatever it may be, if you are preparing dry, semi-dry or wetted materials, why not investigate what Simpson Mix-Mullers can do for your product or process.

Mixing is our business . . . our only business for over 37 years.

National Engineering Company

Blaw-Knox electro-vapor kettles®

squeeze the most from each BTU



Blaw-Knox Electro-Vapor Kettles put heat to work quickly, efficiently and with a minimum of loss.

From a cold start, electrical immersion heaters rapidly vaporize Dowtherm which transfers its latent heat to the inner vessel by condensation. The vaporization-condensation cycle is continuous. The heat is uniform, accurately controlled and most efficiently utilized. There are no boilers or brick settings to heat—no piping systems through which heat is lost.

Blaw-Knox Electro-Vapor Kettles are simple in operating principle and practically maintenance-free. The initial cost and space requirements for these compact, self-contained units are less than those for standard Dowtherm heated vessels, which require external boilers and piping systems.

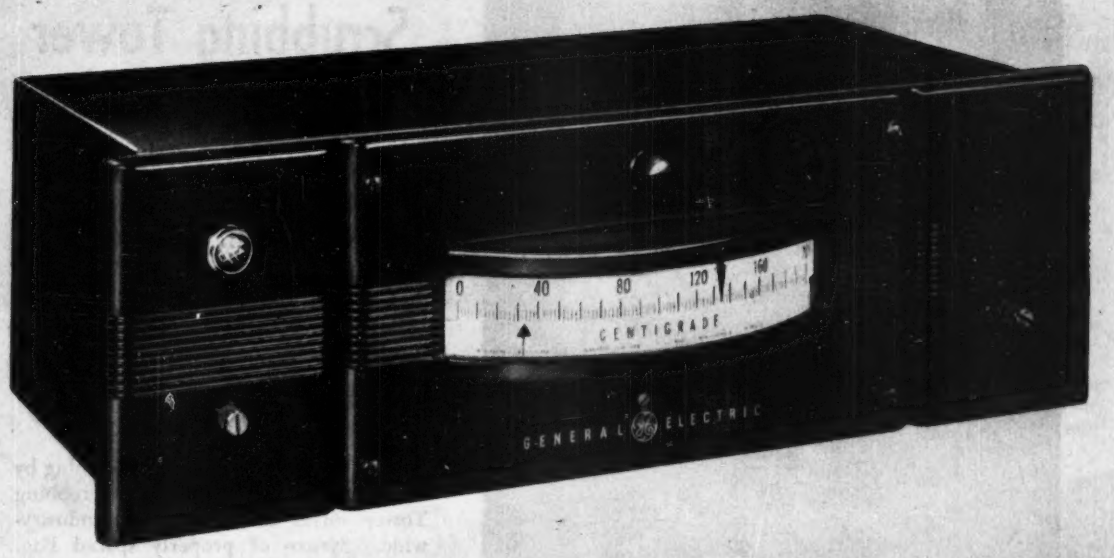
For additional information, write for Blaw-Knox Bulletin 2324. There's no charge or obligation.

BLAW-KNOX

BLAW-KNOX COMPANY

Blaw-Knox Equipment Division
Process Equipment Department
Pittsburgh 38, Pennsylvania

PROCESS INSTRUMENTATION



3-way Protection Against Heat Damage Provided by G-E Pyrometer Controller

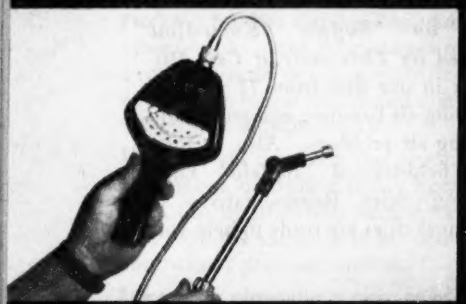
Your profits burn up when uncontrolled heat damages the payload of a furnace.

PROTECTION AGAINST COSTLY HEAT DAMAGE is provided by the General Electric pyrometer controllers in threeways. Heat is automatically shut off, when: a thermocouple fails, power to the instrument is disrupted, or the tube burns out or loses emission.

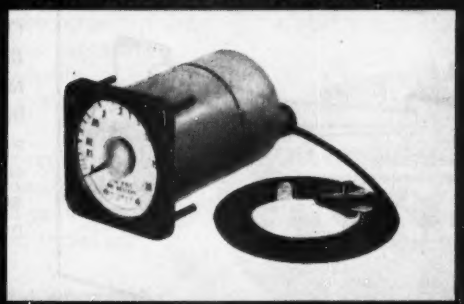
PRICES START AT $215.78* for the General Electric line of pyrometer indicating controllers. Available in 2-position and 3-position models, these instruments offer a variety of ranges in the 0-3000F span.

*Manufacturer's suggested retail price.

VERSATILE HAND PYROMETER



NEW MOLECULAR VACUUM GAGE



BULLETINS AVAILABLE

SECTION 8602-282
GENERAL ELECTRIC COMPANY
SCHENECTADY, N. Y.

Please send me a copy of the bulletins.

☐ HP Pyrometers, GEC-713
☐ Hand Pyrometer, GEA-6020
☐ Molecular Vacuum Gage, GEC-986

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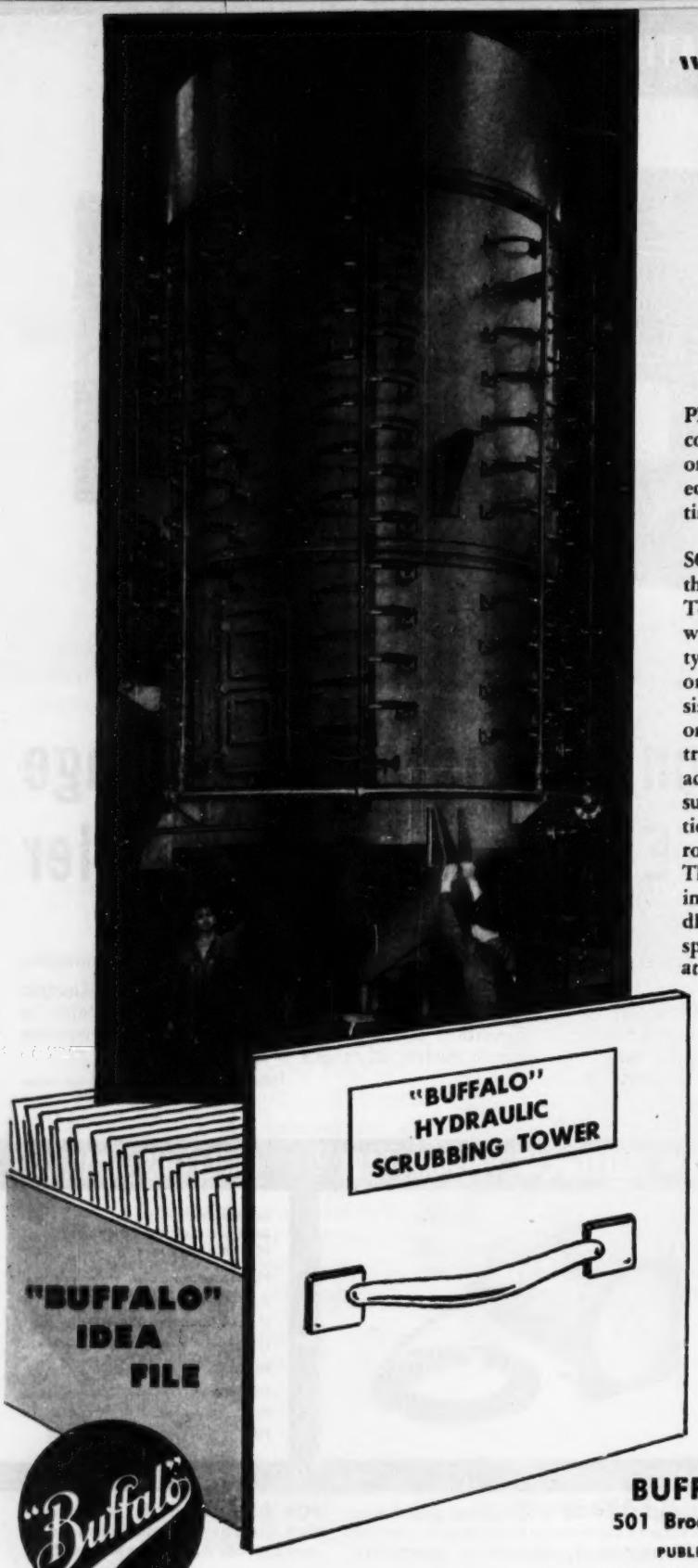
DUAL SCALE widens range of temperature measurement of gas, liquids, surfaces, molten metal (0-1500F).

CONTINUOUS SERVICE: New vacuum gage has no detector tube to burn out or be damaged by inrush of air, if accidentally opened to atmosphere.

FOR DETAILS on the instrument that interests you, send in coupon or contact your Apparatus Sales Office.

GENERAL ELECTRIC



"Buffalo" Hydraulic Scrubbing Tower Cleans Air BETTER

PROBLEMS: Cleaning discharges of hot, corrosive gases, heavy and erosive dusts, or linty, stringy materials. Ordinary equipment becomes plugged in a short time.

SOLUTION: Wet centrifugal cleaning by the new "Buffalo" Hydraulic Scrubbing Tower solves above problems industry-wide. System of properly spaced Fog-type Nozzles creates a fog which jets air or gas thru unit, overcoming its own resistance. Each fog layer condenses the one below, permitting gravity travel of trapped material. This centrifugal spray action, plus scrubbing against a wetted surface, results in extremely high collection efficiency. Clogging, abrasion, corrosion and heat damage are overcome. The Scrubbing Tower is a compact, easily installed and maintained unit now handling many of the most difficult and specialized air cleaning jobs efficiently and at minimum cost.

BULLETIN AP-525 gives further details and applications on these units. Write for your copy today!

Call on "Buffalo" Know-How Backed By Thousands of Case Histories in our files from 77 years of building air handling equipment and solving air problems. Also, factory- and field-trained "Buffalo" Engineering Sales Representatives in principal cities are ready to help you.

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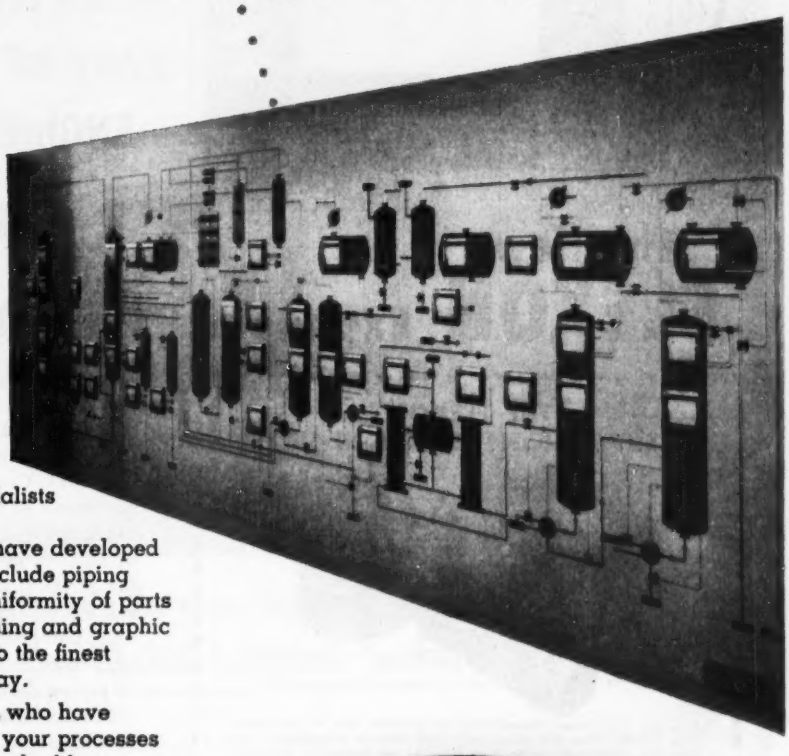
engineered GRAPHIC PANELS by FOXBORO



Working as a team, Foxboro Panel and Process Control Engineers offer you an unequalled resource . . . one which will assure you of the most efficient instrumentation, and the most practical panel layout, for your process.

Foxboro Panel Engineers are specialists in panel design and fabrication. Exclusive techniques which they have developed over many years of experience include piping arrangements, wiring methods, uniformity of parts and accessories, methods of finishing and graphic portrayal — all of which add up to the finest graphic panel work available today.

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If you are planning a new or modernized control room, let us detail a proposal for you, with comprehensive data on Foxboro Graphic Panels.
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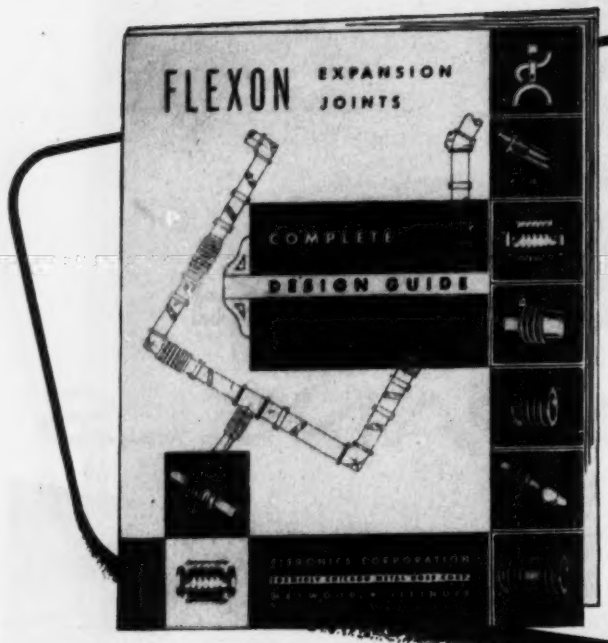

THIS NEW AUTHORITATIVE GUIDE TO PIPING MOTION CONTROL SHOULD BE AN IMPORTANT PART OF YOUR BASIC ENGINEERING FILE

The New FLEXON Expansion Joint Design Guide

THE FLEXON EXPANSION JOINT LINE-UP

Flexonics Corporation manufactures a complete line of corrugated type stainless steel and copper expansion joints in Free-Flexing (low pressure), Controlled-Flexing (high pressure) and Flexoniflex (extremely high pressure) units. Sizes range from ½" to 48". Units are available for temperatures from —400° F., to 1600° F., and for pressures from vacuum to 5500 psi. Write for further information or see the Flexonics catalogs in Sweet's Plant Engineering File, Chemical Engineering Catalog or The Refinery Catalog.

Now at last, comprehensive, up-to-date information on the absorption of motion in piping has been gathered together in one easy-to-use booklet. In its new Expansion Joint Design Guide, Flexonics Corporation offers an authoritative handbook of piping design and layout! Included in the booklet are thorough discussions of types of motion, design considerations pertaining to the physical characteristics of expansion joints and anchoring and guiding, typical piping layouts, computation of thermal expansion, safety factors and many other vitally important factors in piping design.

Much of the information presented is available nowhere else; all of it helpful to anyone responsible for the design, installation or maintenance of piping. Copies of the Flexon Expansion Joint Design Guide are available without charge. Write for your copy, today.

Flexonics Corporation EXPANSION JOINT DIVISION 1317 S. THIRD AVENUE • MAYWOOD, ILLINOIS

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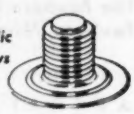
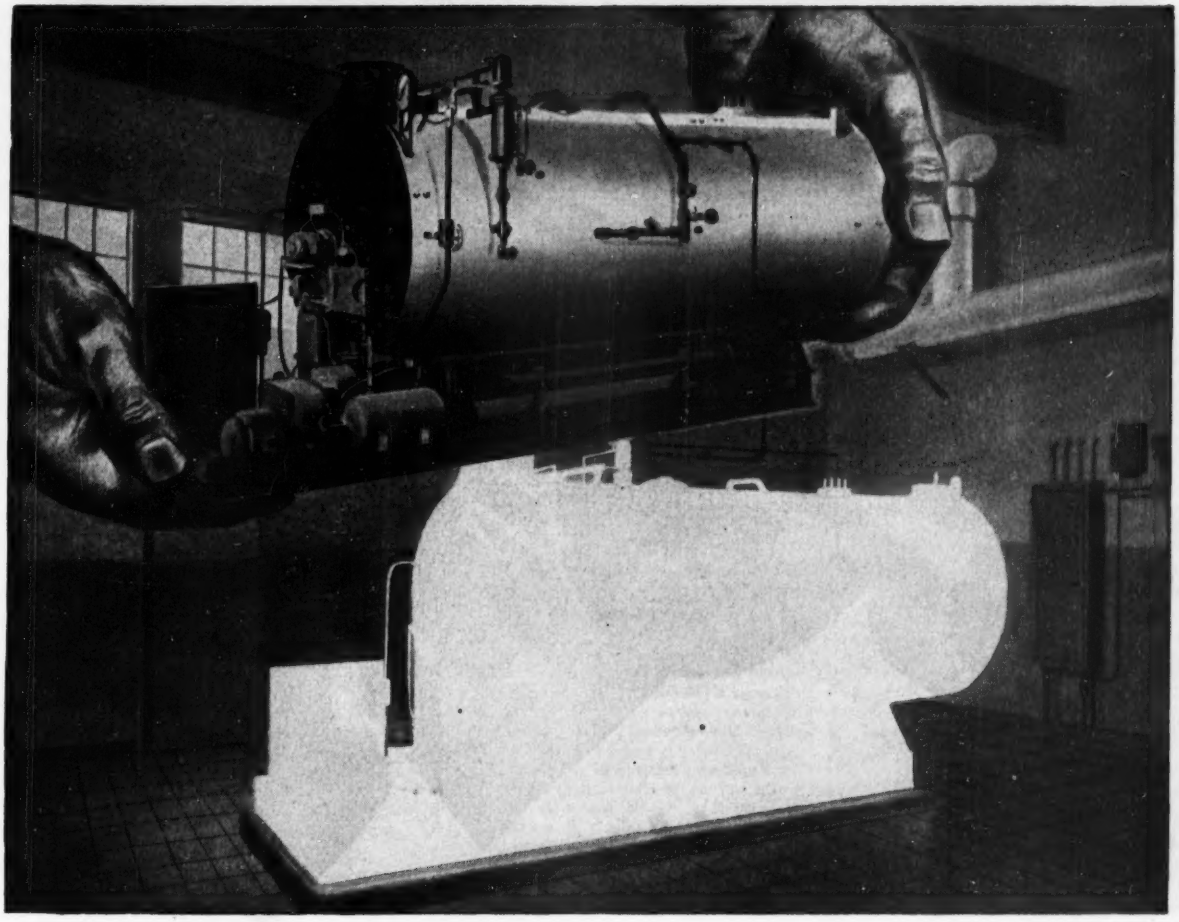


Here's why you get more...when you buy a Cleaver-Brooks Self-Contained Boiler



...only Cleaver-Brooks can offer you the experience gained from more than 20 years of pioneering . . . and more than 12,000 individual "packaged" boiler installations

CLEAVER-BROOKS pioneering has been largely responsible for simplifying boiler buying . . . lowering costs of installation . . . delivering 80% guaranteed steam efficiency from every fuel dollar when firing with oil.

Boilers can be shipped as completely assembled and tested self-contained units, with auxiliaries as required. Installation involves minimum of time, construction and space. Usually connections only to steam, fuel, water lines and electrical service are needed. No special foundations are required. A short vent takes care of exhaust gases. Frequently, boilers are ready for use in a matter of *hours*, depending on availability of service lines.

Cleaver-Brooks, originators of the self-contained boiler, offers wider experience that counts in another important way. Qualified engineers help you plan steam plants tailored *exactly* for your needs. Carefully analyzed are loads, space and equipment arrangement. This not only helps you solve present steam needs, but adds flexibility for future expansion as well.

This application engineering, plus basically sound design and construction is your assurance of a full return from your boiler investment. When you specify a self-contained boiler — make sure it's a Cleaver-Brooks.

Send for Catalog AD-100 for full details on Cleaver-Brooks boilers. Available for oil, gas and combination oil/gas firing. Sizes 15 to 500 hp, 15 to 250 psi — for heating and processing.

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ORIGINATORS OF THE SELF-CONTAINED BOILER

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The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

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- Saves floor space.
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U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

Cover Story Features Allethrin Synthesis

The cover story of the March issue of *Industrial and Engineering Chemistry* gives interesting details on an important U.S.I. accomplishment: the construction and operation of the nation's first full-scale plant for the synthesis of Allethrin, a highly effective insecticide. Photographs and two flow sheets describe the plant's 18-step process, and the present and future uses of Allethrin are discussed. The article, "Staff-Industry Collaborative Report: Allethrin," was jointly prepared by the U.S.I. technical staff and *I&EC*. Be sure not to miss it.

Bone Fractures Require More Methionine to Heal

Experiments using methionine tagged with radioactive sulfur indicated that methionine metabolism increases during healing of bone fractures. The experiments were conducted on mice *in vitro* and *in vivo*.

Compared with controls, the methionine metabolism increased 3-5 times in bone fracture areas.

This work adds to the many examples of the increased need for methionine in healing processes where tissue is damaged, such as wounds and burns, as well as bone fractures.

Use of CIPC Brings Weed Control Savings

In a recent article on the use of CIPC to control weeds in cotton, savings which more than pay for the cost of the chemical are reported. Chemical weed control is said to be the missing link in the complete mechanization of cotton production, with CIPC described as the chemical which is taking much of the hand labor out of this phase of cotton growing.

Among the important conclusions reached from work with CIPC are: weeds can be controlled in cotton more cheaply with CIPC than by other means; cotton that is kept free of weeds throughout the growing season will yield more, since there will be less competition from grass and weeds; the problem of recruiting and managing day labor has become a big headache, and most growers would like to see this eliminated; and through the use of CIPC, it is possible to get a better job of weed control with less injury to cotton than any other known method.

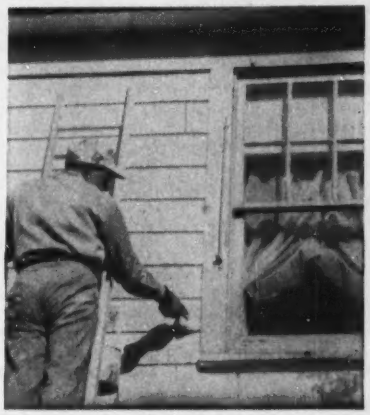
CIPC has many other promising uses for the control of weeds. It is being successfully used with soybeans, sugar beets, certain legumes, vegetable crops, strawberries and other crops.

U.S.I. produces both CIPC and IPC for formulators, who prepare ready-to-use herbicides for the farmer. Technical data on CIPC and IPC are available upon request.

New U.S.I. Alkyd Promises Longer Life, Better Appearance For Exterior House Paints

Should Save Many Dollars for American Homeowners

A new U.S.I. alkyd resin promises longer-lasting and better-looking outside house paints. Called Aroplaz 1400, it is the result of more than 7 years of research and practical testing. Paints containing this new resin should bring greater economy in home maintenance, since the major cost of painting a house is labor, not paint. From all indications, homes painted with Aroplaz 1400 paints will maintain a better looking appearance for a longer period of time. This should save money for the user by requiring less frequent repainting.



The longer life of house paints made with new Aroplaz 1400 promises less frequent repainting and money saved for the user.

Described as a pure, low viscosity alkyd, Aroplaz 1400 can be used in white or tinted paints in place of all or part of the oil (linseed, for example) used in ordinary house paints. Alkyd resins are widely recognized for their excellent durability by the paint and varnish industry, and now with Aroplaz 1400, the paint manufacturer may successfully incorporate this valuable alkyd resin property in his house paint formulations.

Created by Researchers

Aroplaz 1400 is the product of imaginative research work by U.S.I. As a basic producer of raw materials for the paint industry, U.S.I. continually searches for better products and improved processes. Many of these, such as Aroplaz 1400, offer paint manufacturers an opportunity to improve their products.

The new alkyd resin was created by starting with a series of fast drying, low viscosity alkyds which researchers thought potentially outstanding for use in house paints. One of these alkyds gave superior results in every way with the exception of brushing, which was rated as fair to good. Based on this background, an alkyd resin was developed possessing

MORE

New Process Offers Organic Peroxide Source

A new process using gum turpentine for the production of pinane hydroperoxide has been developed. Described as simple, rapid and economical, it offers a potential source of organic peroxides especially suitable for polymerization catalysts in the production of synthetic rubber, resins and plastics.

The process is said to have four main steps: hydrogenation of the turpentine to give pinane; purification of the pinane, usually by simple distillation; oxidation of the pinane to a peroxide content of about 50 percent; and stripping the oxidate under vacuum to recover the unoxidized pinane, leaving pinane hydroperoxide as a residue.

According to one of the men who developed the process, 8-pound batches of turpentine yield about 4-pounds of 80 to 90 percent pure peroxides. In earlier development work, chemists prepared a pure form of pinane hydroperoxide and established its chemical structure as cis-l-pinane 2-hydroperoxide.

Treated Paper Protects Food From Boring Insects

Food packaged in paper that had been treated with insecticide formulations containing pyrethrins and piperonyl butoxide (Pyrenone®) was successfully protected from boring insects in recent laboratory tests. According to the report, the treated paper gave protection for periods of time ranging from 2 months to more than a year, depending on the dosage and type of formulation.

The problem of protecting foods packaged in paper bags and packages from insects is important in the food industry. The new method of packaging in treated paper promises to be of considerable economic value to food packagers. Paper treated with the most effective formulation repelled boring insects for more than a year, while untreated papers were penetrated in about 1 week.

The report, which appeared in a leading food chemistry magazine, was prepared by the Research and Development Laboratories of U.S.I. Combinations of pyrethrins and piperonyl butoxide can be used on food containers with no toxic hazards and are marketed by U.S.I. under the registered trademark Pyrenone.

U.S.I. CHEMICAL NEWS

CONTINUED

New Alkyd for House Paints

all the desirable properties in addition to excellent brushing characteristics. The result was Aroplaz 1400.

Tests Show Superiority

Exposure tests show the advantages of alkyd exterior house paints over straight house paints. Cleaner, whiter surfaces are observed after exposure. Furthermore, the alkyd-base coatings are better than straight-oil paints in over-all durability. U.S.I. tests continue to add evidence that extremely high quality house paints can be produced by the use of Aroplaz 1400. Important advantages, such as improved gloss-retention, cleanliness and general appearance are apparent throughout the life of the paint. Moisture-blistering, one of the greatest causes of house paint failure, is more effectively resisted, and Aroplaz 1400 paints are superior to conventional oil house paints in freedom from metal-staining. Tests also have indicated that Aroplaz 1400 paints give equal ease of brushing.

Future uses for Aroplaz 1400 should include bulletin colors, trim paints, emulsion and awning paints in addition to house paints.

Aroplaz 1400, experimentally known as resin DX-159, is now in commercial production and is supplied at 100% solids content. Much data has been collected over the years in the testing of alkyd house paints. Detailed information, including suggested formulations, is now available to paint manufacturers who wish to make independent investigations.

For further information, paint manufacturers should write directly to the Editor of the U.S.I. Chemical News.

New Flowmeter Saves Time

Claimed to be the first of its kind ever produced, a gyroscopic mass flow meter measures the flow of gases, liquids or slurries. The new meter reads directly in pounds per minute or tons per hour and is expected to save time for process engineers who labor long hours converting volumetric measurements.

New Paper Gives Copies Without Carbon Paper

Paper which gives copies of business forms or letters without the use of carbon paper has been introduced. The new paper utilizes the reaction of a colorless chemical coating with a clay-like material and is expected to receive widespread use in the business world.

Advantages of the new carbonless system are said to include the elimination of smudging, speeded efficiency in handling forms, and an end to the dirt and bother of duplication with carbon paper inserts.

According to the manufacturer, two different coatings on ordinary paper are used in combination to give the desired number of copies. If, for example, an original and two copies are wanted, the underside of the first sheet is coated with the colorless chemical and the topside of the second sheet with the clay-like coating. The impact of the typewriter character or the pressure of a pencil on the first sheet drives the colorless chemical coating into contact with the clay-like coating on the topside of the second sheet. This causes an immediate chemical reaction which turns the clay-like material blue and leaves a clean, sharp impression on the second sheet. This process is repeated with the second and third sheets, the back of the second sheet also being coated with the colorless chemical. Reportedly, up to seven copies can be made on an electric typewriter.

New Mold Release Agent Has Variety of Uses

Developed in conjunction with resin manufacturers, a new mold release or parting agent offers a variety of uses to plastic fabricators. It is described as providing a ready release from molds of polyester resins and as being useful in both large and small fabrications. The material is said to find extensive use in cold molding and is supplied as a paste in two consistencies to accommodate varying conditions and types of molds.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

An improved laboratory washer, said to handle everything from over-size graduates to micro pipettes, is available. The manufacturer claims that a new series of glassware baskets extend the washer's versatility. **(No. 1020)**

An appetite stimulant and nutritional supplement useful in aiding appetite failures from old age or convalescence has been announced. It is said to provide balanced amounts of nutritional elements including B-complex factors and iron. **(No. 1021)**

A starting fluid especially suited to diesels is designed to eliminate the need for storing equipment in heated quarters to insure easy starting. Applied to the air stream of any diesel or gasoline engine, it reportedly offers sure-fire starts. **(No. 1022)**

A tough silicone rubber with a tear strength 2 to 3 times higher than any other silicone rubber is now in production. It is expected to find widespread use as a gasketing material in chemical processing equipment, where high temperature, pressure or vacuum exist. **(No. 1023)**

A new moisture determination instrument, reported to be the first advance in over twenty-five years using the xylol or toluol distillation technique, may save enough time to pay for itself in a few months. It is described as portable and as a complete unit within itself. **(No. 1024)**

Cement colors which are fast to alkali are available. According to the manufacturer, they can be mixed or trowled into the cement. **(No. 1025)**

A chemically inert, pipe-thread sealing compound prevents spiral wicking, leakage and contamination. It is said to give a leakproof seal against fluids and gases under pressure and to be suitable for process pipe lines and apparatus. **(No. 1026)**

A material which loosens metal parts stuck together, such as frozen bolts, is available in an aerosol container. It is reported to penetrate into spaces as small as one millionth of an inch, soften rust and dissolve dried oil and grease. **(No. 1027)**

Aimed at keeping drivers awake, a coffee-flavored caffeine pill in a malted milk base is said to be neither habit-forming nor a depressant. **(No. 1028)**

Cold metalizing of surfaces with aluminum is possible with a mixture of finely pulverized aluminum in a plastic base. According to the manufacturer, the mixture hardens to a plastic bonded aluminum surface which can be polished, ground, drilled or bent to a 45-degree angle without chipping or cracking. **(No. 1029)**

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Completely Denatured—all regular and anhydrous formulas
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Super Pyre* Anti-Freeze
U.S.I. Permanent Anti-Freeze

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Aroplaz*—alkyds and allied materials
Aropol*—copolymer modified alkyds
Ester Gums—all types
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CPR Concentrates: Liquid & Dust
Piperonyl Butoxide
Piperonyl Cyclonene
Pyrenone* Concentrates: Liquid & Dust
Pyrethrum Products: Liquid and Dust
Rotenone Products: Liquid and Dust

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Indalone*
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INTERMEDIATES
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Acetoacet-ortho-chloroanilide
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Acetoacet-para-chloroanilide
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Ethyl Benzoylacetate
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Vacatone* 40

OTHER PRODUCTS
Acetaldehyde
Caustic Soda
Ethylene
IPC (Isopropyl-N-Phenyl Carbamate)
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Liquid Chlorine
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Propionic Acid
Sulfuric Acid
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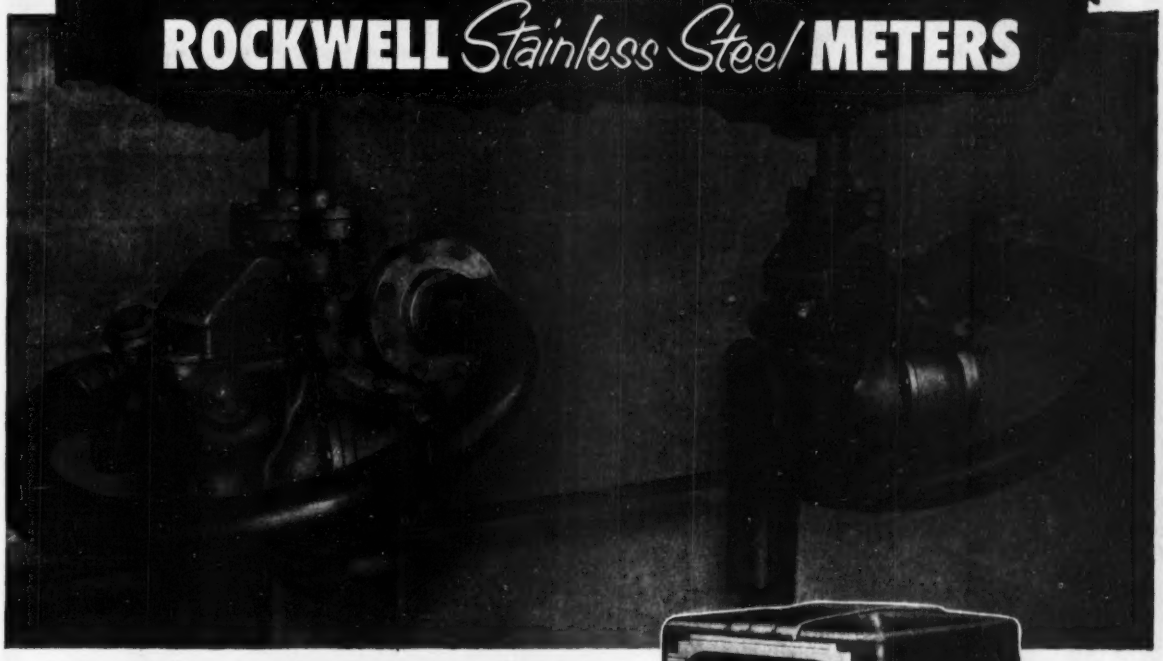

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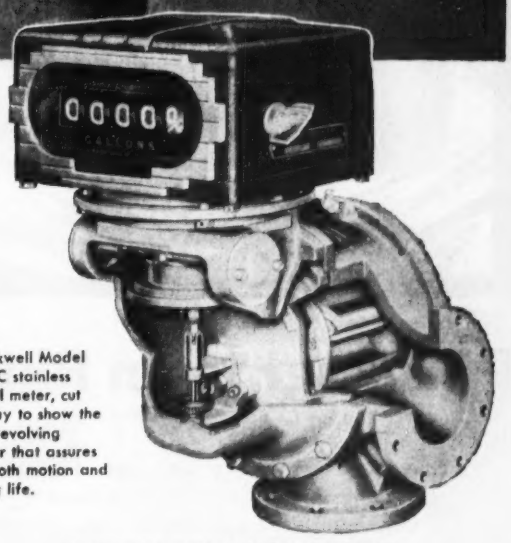
Including Foods, Pharmaceuticals, Chemicals and Liquors

Here's a meter especially designed for accuracy and long life when measuring corrosive liquids. It is constructed *inside and out* of stainless steel. With it you can get positive metered accounting for a multitude of liquids that cannot be handled by ordinary meters. Now you can guard the quality of your formulations; keep tab on liquid inventories; have accurate records for cost control and tax analysis purposes. Use the handy coupon for full details.



Rockwell Model 2-BC stainless steel meter, cut away to show the all-revolving rotor that assures smooth motion and long life.

Use for all these purposes

- LIQUID DELIVERY CONTROL
- COST. CONTROL—DEPARTMENT CONTROL
- FORMULA CONTROL—INVENTORY CONTROL
- PRODUCT QUALITY CONTROL

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YOUR NAME _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____

Phthoughts on Phthalic–by "Doc Barrett"

One good reason why paint makers today nearly all use alkyds derived from Phthalic Anhydride in their interior enamels is the extra *durability* these magic-working chemicals impart.

And there are many other reasons for the popularity of alkyds derived from "P.A." as a paint base. "Doc Barrett" says these include: ease of application, better washability, better adhesion, and a more beautiful, lustrous finish. And he should know because he helped to make possible these special qualities which win extra sales. The cost? Only a few cents to the gallon.

As the world's largest producer of Phthalic Anhydride, Barrett can assure you uniform quality, steady supply and quick delivery. And "Doc Barrett's" technical assistance on your application problems is available without cost.

BARRETT DIVISION, Allied Chemical & Dye Corporation, 40 Rector St., New York 6. In Canada: The Barrett Company, Ltd., Montreal, Que.

Allied Chemical

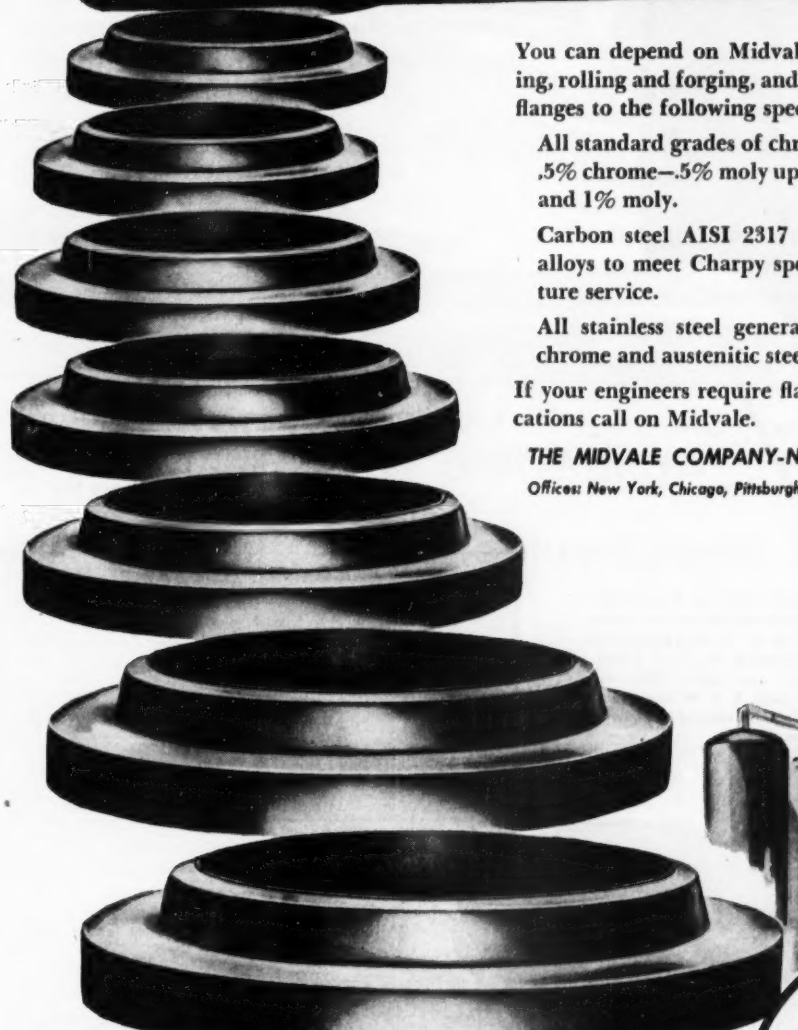
1854 1954

Barrett

BARRETT CHEMICALS

HEADQUARTERS FOR SPECIAL ALLOY STEEL FLANGES

25" I.D. TO 185" O.D.



You can depend on Midvale's complete facilities—melting, rolling and forging, and machining—to produce alloy flanges to the following specifications:

All standard grades of chrome-molybdenum steel from .5% chrome—.5% moly up to and including 9% chrome and 1% moly.

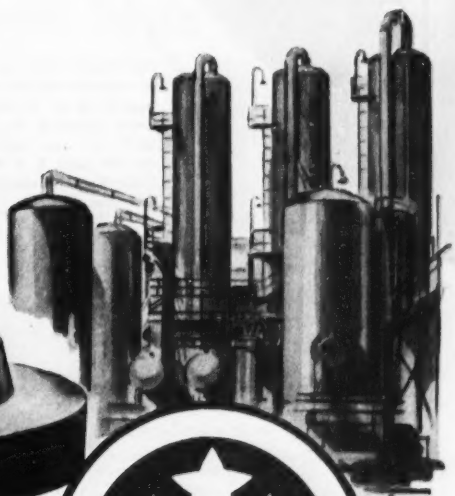
Carbon steel AISI 2317 and chrome, copper, nickel alloys to meet Charpy specifications for low temperature service.

All stainless steel generally required, such as 12-14 chrome and austenitic steels types 304, 316 and 347.

If your engineers require flanges of any unusual specifications call on Midvale.

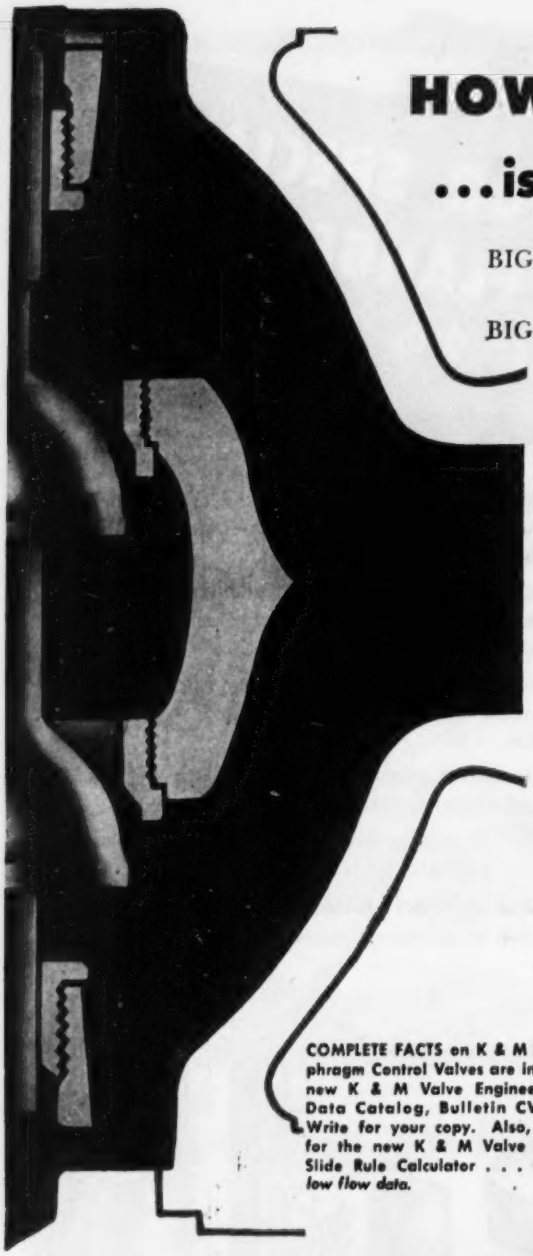
THE MIDVALE COMPANY-Nicetown, Philadelphia 40, Pa.

Offices: New York, Chicago, Pittsburgh, Washington, Cleveland, San Francisco



MIDVALE

FORGINGS, ROLLS, RINGS, FLANGES, STAINLESS STEEL CASTINGS



HOW BIG

...is a K & M six-inch valve?

BIG enough to pass 500 gpm of cold water through the valve body at a constant drop of one pound pressure. BIG enough to provide the largest flow coefficient available in a standard six-inch diaphragm control valve. Body flow passages of all K & M valves, for example, actually average 140% of cross-sectional pipe area. There's more space for fluid to flow . . . smoothly, freely and without turbulence. Frequently a smaller nominal size K & M Valve provides sufficient capacity to satisfy requirements that formerly called for a larger, more expensive valve. Inner valve open areas, on the other hand, average only 80% of cross-sectional pipe area. Therefore, flow restrictions occur principally across the inner valve . . . where the restriction is controllable throughout the entire range of valve stem travel. This K & M design often permits lower initial costs . . . always contributes to more precise flow regulation through the K & M Inner Valve.

COMPLETE FACTS on K & M Diaphragm Control Valves are in the new K & M Valve Engineering Data Catalog, Bulletin CV53. Write for your copy. Also, ask for the new K & M Valve Size Slide Rule Calculator . . . with *low flow data.*

C_V COMPARISON TABLE

Valve Size	K & M	Valve B	Valve C
¾"	10.9	8.4	8
1"	17.3	14.9	12
1½"	39.1	33.2	28
2"	61	57	48
2½"	97.7	71.0	72
3"	150	116	100
4"	219	197	165
6"	500	364	360

Based on the maximum C_V at rated travel through the valve body. From manufacturers most recent slide rules or tables.

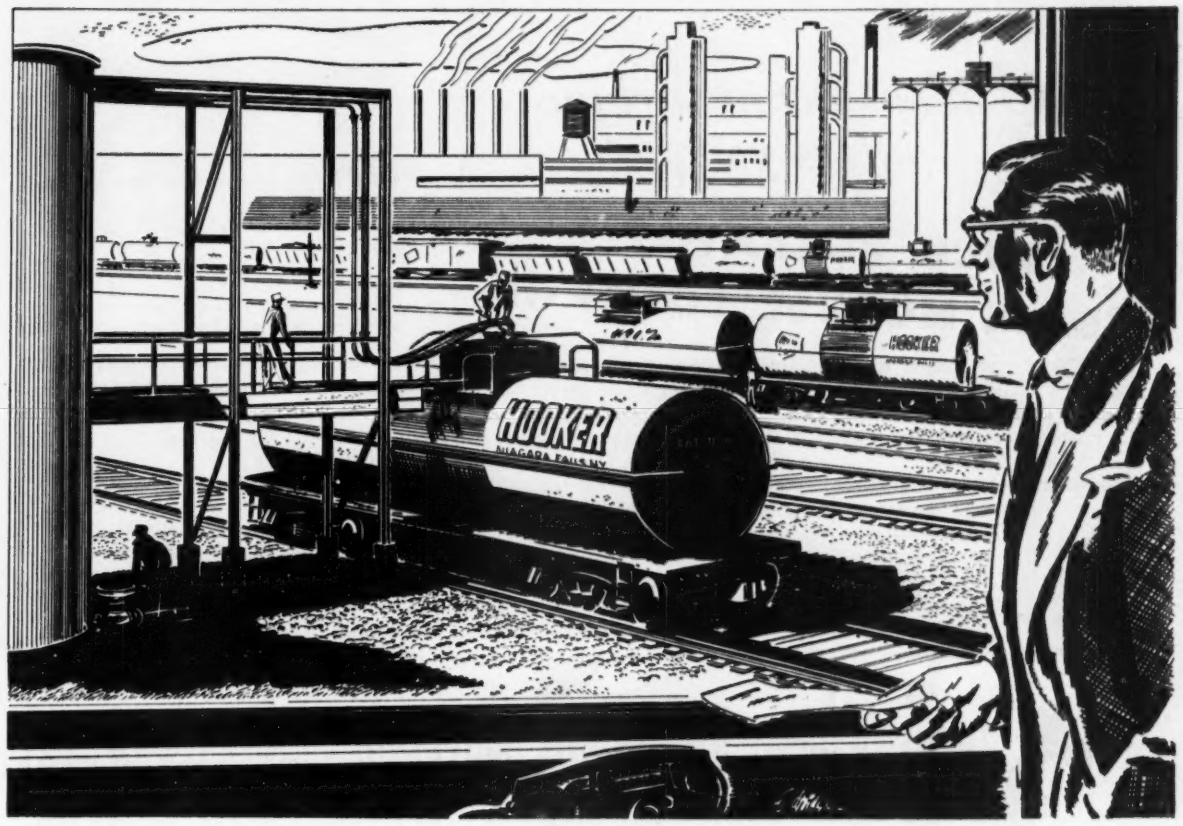
diaphragm control valves

KIELEY & MUELLER, INC.

K&M

Valve Makers Since 1879

64 Genung Street
Middletown, New York



For smoother, better processing—
buy the Uniformity Hooker Caustic Soda gives you

Month after month, year after year—you can standardize processing methods, and get consistent results, when you use Hooker Caustic Soda.

You need never adjust your process to meet variations in caustic soda shipments. You can be sure each new shipment closely matches your current inventory.

Uniformity, from shipment to shipment, is the result of close quality checking at Hooker. More than a score of inspections and analyses safeguard the uniformity of the Hooker caustic you buy.

Do you agree, with leading companies in 30 different industries, that this is a good reason to *standardize* on Hooker caustic soda?

If you do, a letter or a phone call to the nearest Hooker plant or office will quickly bring you the product data and other facts you need to make your decision.

You can *standardize* on Hooker Caustic Soda

Forms: Liquid 50% and 73% • Flake • Solid • Special fine flakes

Containers: Tank cars • Tank wagons • Barges • Drums

For fast service, phone:

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LOS ANGELES	NEvada 6-3826
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HOOKER CHEMICALS

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

HOOKER ELECTROCHEMICAL COMPANY
5 Forty-Seventh St., Niagara Falls, N. Y.

Please send ☐ data sheets on Hooker Caustic Soda; ☐ Bulletin 100 describing Hooker products and services.

Name..... Title.....

Company.....

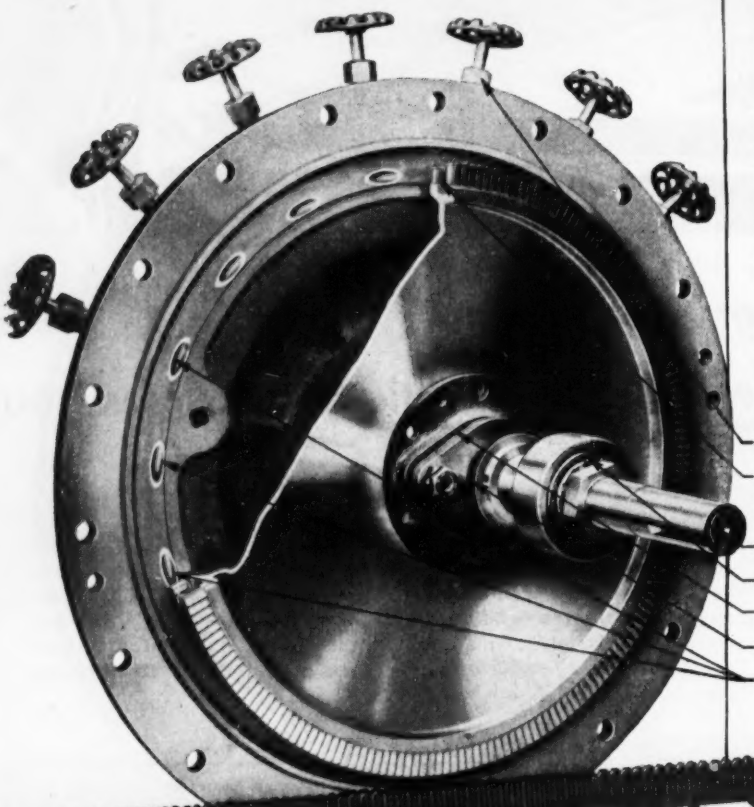
Address.....

City..... Zone..... State.....

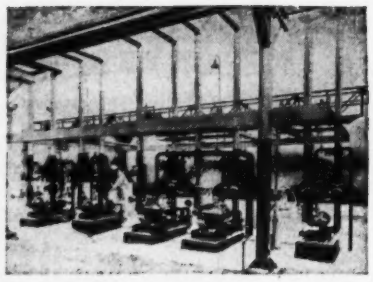
No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



- 7 hand valves for efficient partial load operation, (20" turbine shown)
- 2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced
- 30-40 carbon steel shaft
- Oversized double row deep grooved ball bearing
- Stuffing box with metallic packing ring
- Heavy chrome plating of shaft through stuffing box
- 3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

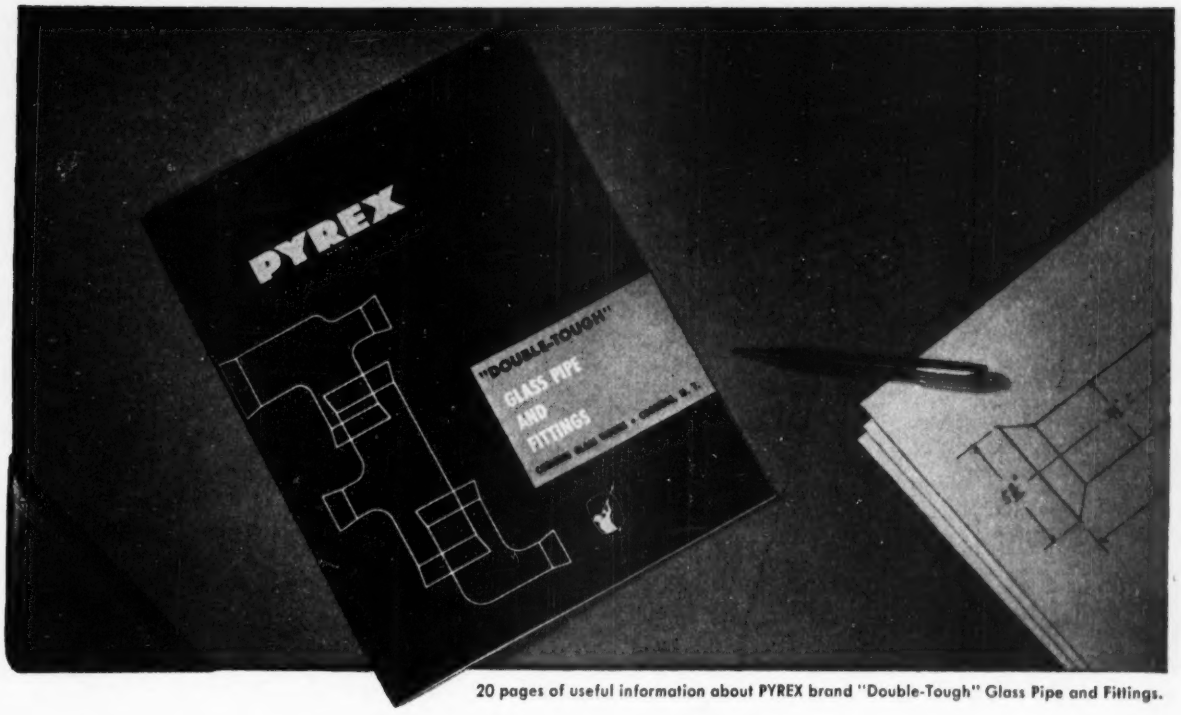
MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP.,
224 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES



20 pages of useful information about PYREX brand "Double-Tough" Glass Pipe and Fittings.

This new catalog describes the most practical means of fighting *pipeline corrosion and contamination*

The new PYREX brand "Double-Tough" Glass Pipe Catalog describes the basic properties that make PYREX pipe the solution to most acid-handling pipeline problems. It catalogs completely what's available in PYREX pipe and fittings.

Cost-reducing improvements

The new catalog lists for the first time two pipe joint improvements that contribute substantially to lower installation and maintenance costs—a new molded insert and a new snap-on gasket.

The molded insert reduces any tendency toward leaky joints. The snap-on gasket, made of Teflon, will stand up to the severest acid corrosion service.

Together, the new insert and gasket reduce the assembly of PYREX pipe joints to a one-man job. Friction holds the insert in place on the pipe ends and tough brass clips correctly position the gasket between the pipe ends while the joint is pulled up tight. Both are described on page 12 of the catalog.

You may find it convenient to have this new PYREX pipe catalog at hand. The distributor nearest you will be glad to send you a copy without further obligation on your part. If you do not know him, just fill out and mail the coupon direct to us at Corning.

Contents of new PYREX pipe catalog

- Performance
- Corrosion resistance
- Operating temperatures and pressures
- Physical characteristics
- How PYREX pipe is made
- Economy
- Cleaning
- Installation
- Pipe specifications
- Stock fittings
- Non-stock fittings
- Spacers for making length adjustments
- Adjustable joints
- Sink traps
- Stock valves
- Joints
- Flanges, gaskets, inserts
- Adapters for connecting with other materials
- Special fittings
- How to order

CORNING GLASS WORKS
CORNING, NEW YORK

Corning means research in Glass

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Please send me a copy of the new PYREX brand "Double-Tough" Glass Pipe Catalog.

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

STANDARDIZE!

ECONOMIZE!

with the bushing that's interchangeable

TAPER-LOCK

A PATENTED PRODUCT OF DODGE

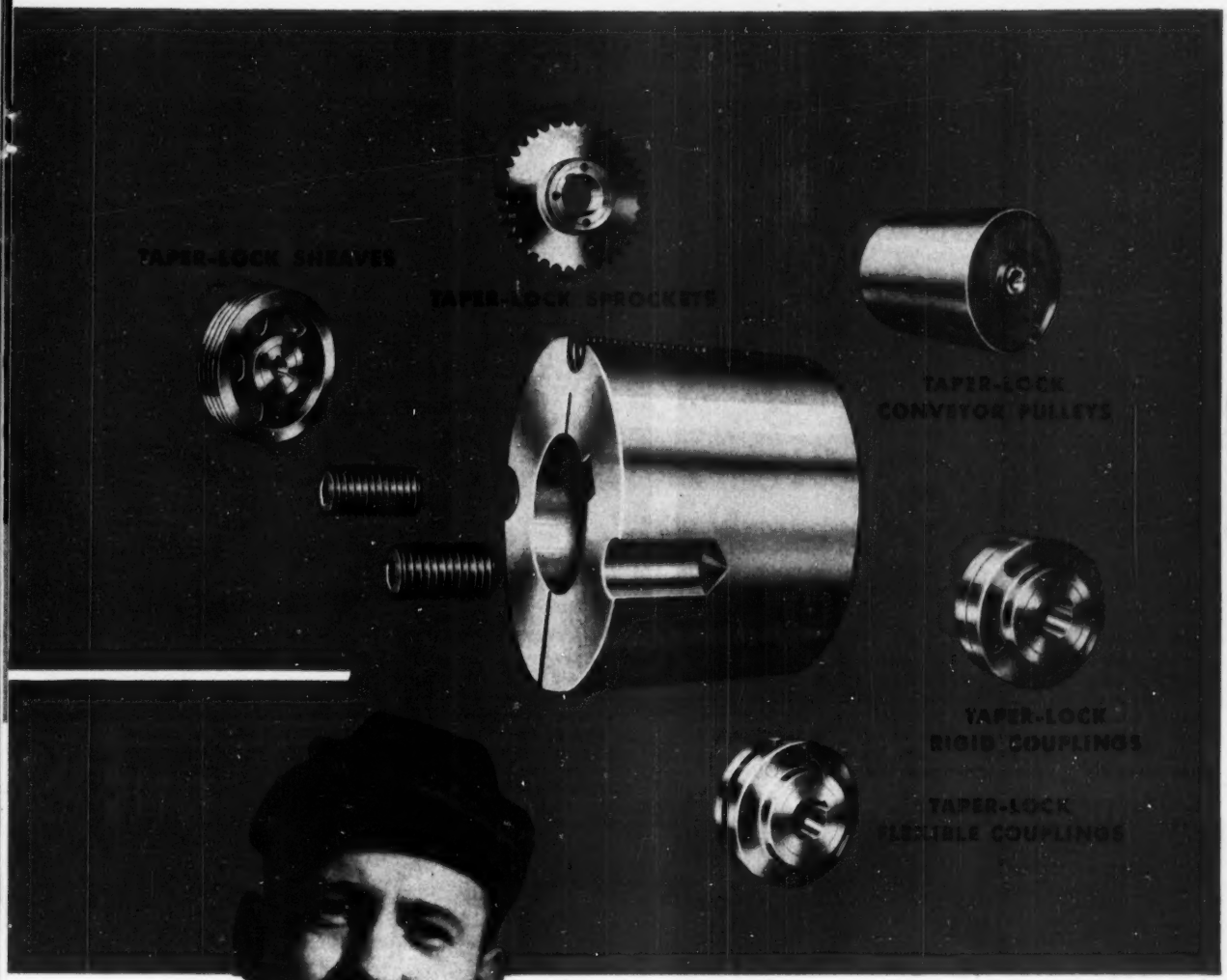
Now mount 'em all—your sheaves, sprockets, couplings, conveyor pulleys —with Taper-Lock bushings. You'll save time, save money, and keep production rolling by standardizing on these interchangeable bushings.

Taper-Lock, a patented product of Dodge, provides the simplest, surest means of mounting wheels on shafts. Dodge Taper-Lock products slip onto the shaft easily, quickly—hold with the firmness of a shrunk-on fit. They come off easily—no hammer, no crowbar, no shock to bearings or machinery.

Taper-Lock bushings fit in every one of the Dodge products pictured above. You can shift from a sprocket to a sheave, for instance, and use the same bushing. And Taper-Lock bushings are available in a range of sizes which makes changing from one size shaft to another equally easy and quick.

With a few Taper-Lock bushings you can make quicker changes and cut down-time on production machines. Get the facts now.

DODGE MANUFACTURING CORPORATION, 200 UNION STREET, MISHAWAKA, INDIANA



THERE'S ONLY ONE TAPER-LOCK,
THE BUSHING THAT MOUNTS FLUSH!

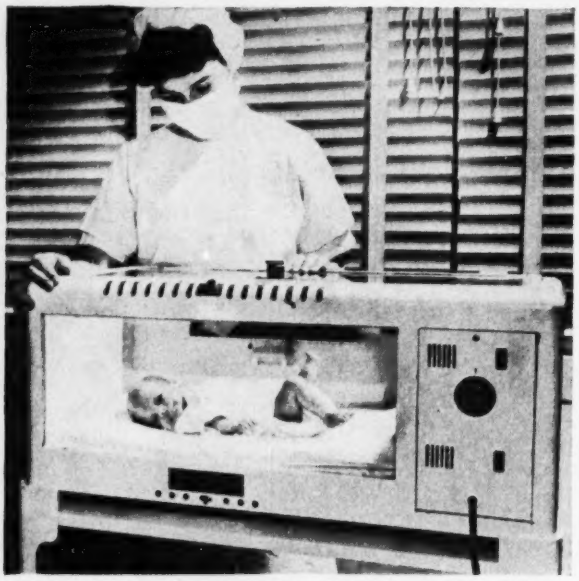
DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor, for valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified phone book, or write us.

How would YOU solve these two problems?

1. MEN AND WOMEN BOTH like nylon fabrics. Important key to producing successful nylon fabrics is the heat-setting process. Temperature-control must be accurate, and reliable yet readily adjustable. "National" Nylon Heat Setting Machines used by the leading textile mills employ THERMOSWITCH® units in the heated rollers . . . get highest efficiency . . . greatest safety . . . most economical fuel consumption.



2. BABY INCUBATOR MUST BE SAFE. Engineers who design Armstrong Baby Incubators say "Safety is a *must* where babies are concerned. That is why all our baby incubators are tested and approved by Underwriters Laboratories. That is why we use only Fenwal THERMOSWITCH units to control all-important temperature and humidity. Inspection reports on more than 22,000 THERMOSWITCH units show a remarkable picture of consistent reliability."

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.

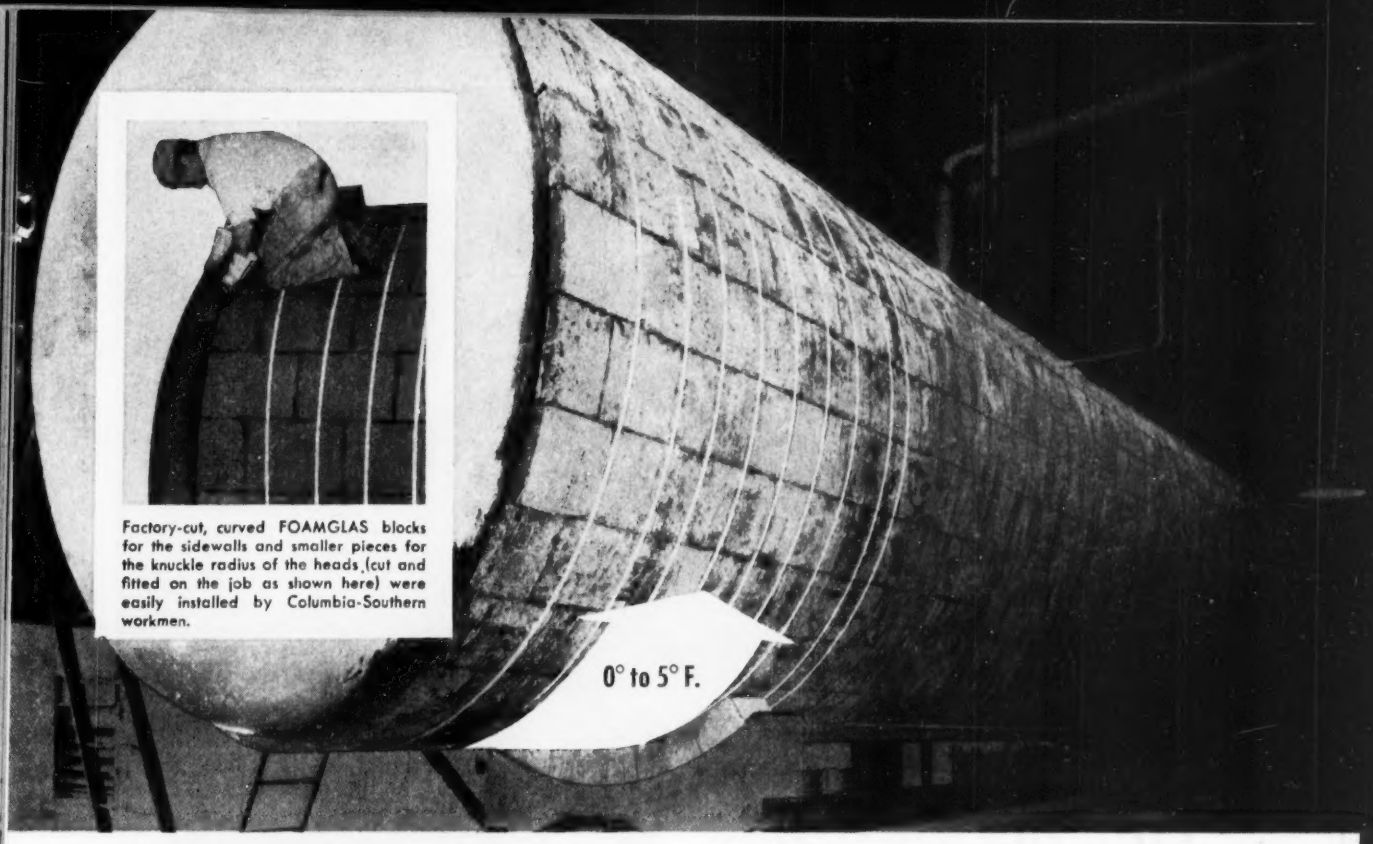
4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 164 Pleasant St., Ashland, Massachusetts.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*



Factory-cut, curved FOAMGLAS blocks for the sidewalls and smaller pieces for the knuckle radius of the heads (cut and fitted on the job as shown here) were easily installed by Columbia-Southern workmen.

FOAMGLAS tank insulation solves a costly maintenance problem for COLUMBIA-SOUTHERN

FOAMGLAS insulation on five chlorine weighing tanks has practically eliminated expensive insulation replacement and maintenance for Columbia-Southern Chemical Corporation. Chief Engineer G. L. Cobb of their Natrium, West Virginia, plant explains:

"Previous tank insulations absorbed too much moisture. Since the equipment operated at 0° to 5° F., the moisture formed ice behind the insulation separating it from the tank walls. As a result, the old insulation constantly fell off, and frequent replacement was necessary.

"FOAMGLAS solved this problem because it *stays dry* . . . its sealed glass cells *can not* absorb moisture. Since we installed FOAMGLAS more than six years ago, maintenance and replacement have not been a problem. Furthermore, its moisture-proof property has assured us constant insulating efficiency."

Solve *your* insulating problems with FOAMGLAS, the unique cellular glass insulation. It is moisture-proof, acid-proof, fireproof and has a strong, rigid structure.

Send for our new booklets describing its use for tanks and other equipment; piping; or walls, floors, roofs and ceilings. It'll pay you to use the handy coupon right away.

G. L. Cobb, Chief Engineer
Columbia-Southern Chemical Corp.

PITTSBURGH CORNING CORPORATION
One Gateway Center • Pittsburgh 22, Pa.

FOAMGLAS®

the cellular, stay-dry insulation

PITTSBURGH PC CORNING

Pittsburgh Corning also makes PC Glass Blocks

Pittsburgh Corning Corporation, Dept. H-44
One Gateway Center, Pittsburgh 22, Pa.

Please send me a free sample and the following brand new FOAMGLAS literature:

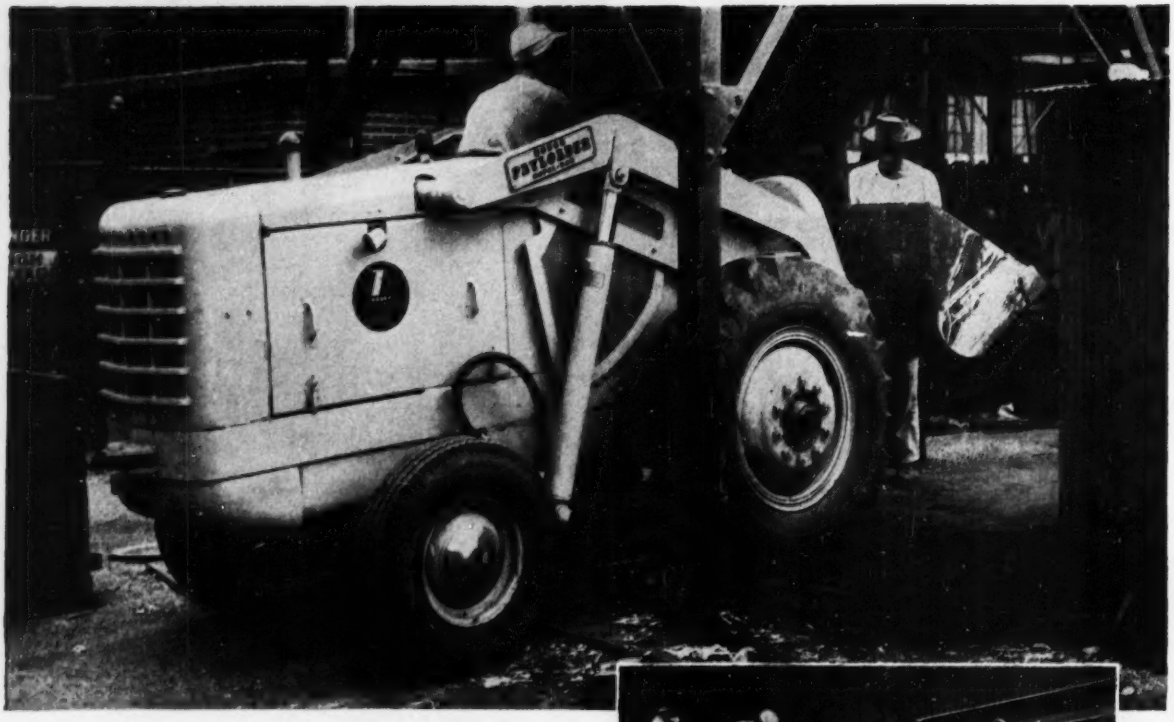
- ☐ New booklet on FOAMGLAS building insulation.
- ☐ New booklet on FOAMGLAS low temperature insulation.
- ☐ New folder on FOAMGLAS pipe insulation.
- ☐ New folder on FOAMGLAS insulation for tanks and other equipment.
- ☐ Send engineer to discuss specific problem.

Name_____

Company_____ Title_____

Address_____

City_____ Zone____ State_____



One-ton dust pan

"PAYLOADER" tractor-shovels pay dividends umpty eleven ways handling bulk, loose materials in all kinds of industries. One of the most interesting is at this foundry and machine shop. The "PAYLOADER" positions its bucket under the hopper of the dust collector, the gate is opened and a ton or more of dust flows quickly into the bucket through a canvas boot — a clean, dust-free operation.

Scooping, shoveling, digging, carrying, spreading and all sorts of lifting, loading, unloading and hauling jobs both indoors and outdoors are "PAYLOADER" duties in thousands of plants. Multiple speeds in both directions, short-turning ability and easy-handling enable them to work fast in close, awkward places.

It will pay you to find out how modern "PAYLOADERS" can improve your output and simplify your material-handling problems. The Frank G. Hough Co., 754 Sunnyside Ave., Libertyville, Illinois.

Bentonite and other bagged materials are quickly carried from boxcar and stacked. Hydraulic power gives precise bucket control.

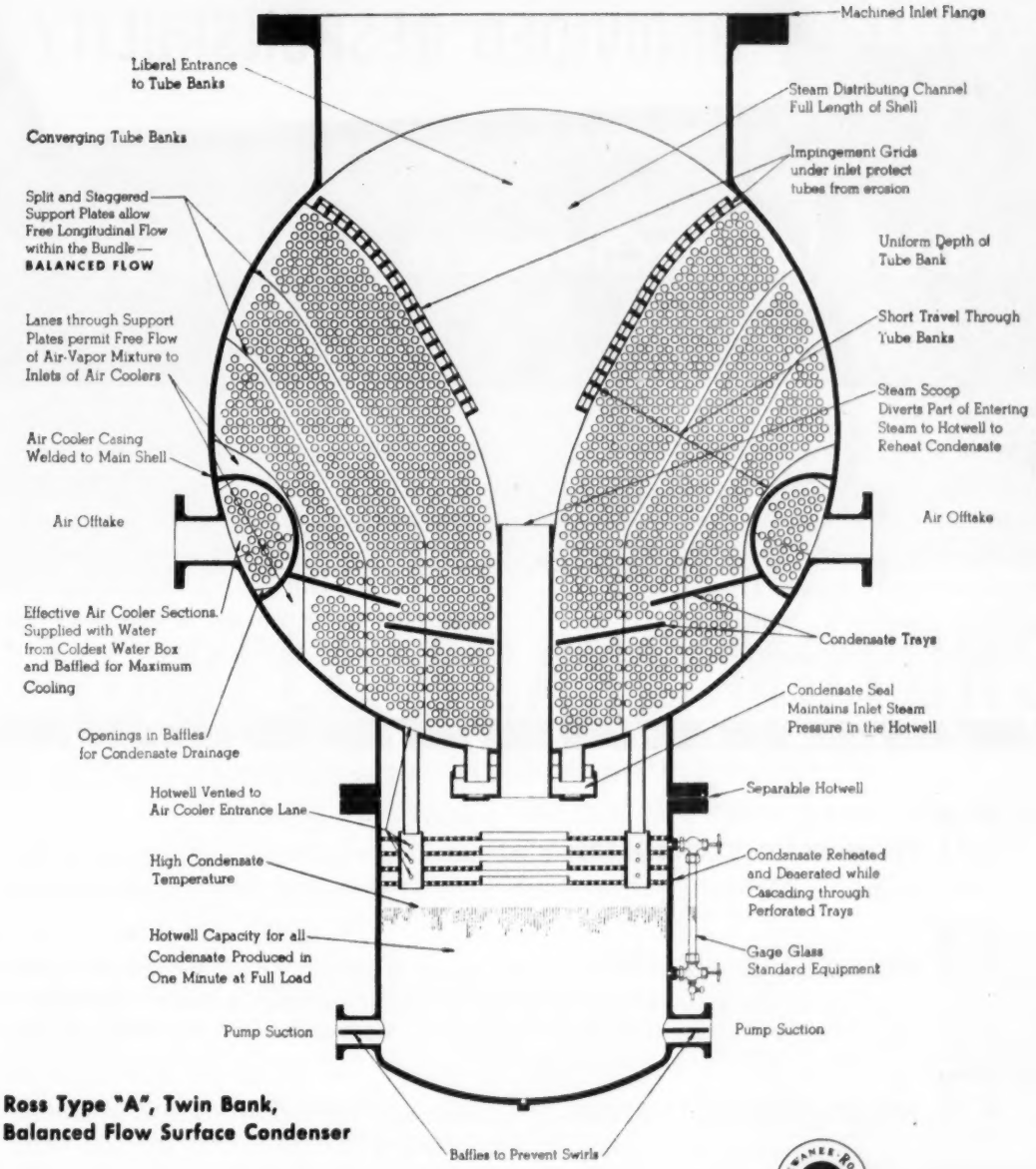
JOB STUDIES are available, illustrating and describing operations in several different plants. These helpful, authorized studies can be secured on request, without obligation.

YOU CAN'T COMPETE IF YOUR EQUIPMENT IS OBSOLETE

SAY "HUFF"

PAYLOADER®

Design features that make Ross Surface Condensers A SOUND INVESTMENT


Machined Inlet Flange
Liberal Entrance to Tube Banks
Converging Tube Banks
Steam Distributing Channel Full Length of Shell
Impingement Grids under inlet protect tubes from erosion
Split and Staggered Support Plates allow Free Longitudinal Flow within the Bundle — BALANCED FLOW
Uniform Depth of Tube Bank
Short Travel Through Tube Banks
Lanes through Support Plates permit Free Flow of Air-Vapor Mixture to Inlets of Air Coolers
Steam Scoop Diverts Part of Entering Steam to Hotwell to Reheat Condensate
Air Cooler Casing Welded to Main Shell
Air Offtake
Air Offtake
Effective Air Cooler Sections Supplied with Water from Coldest Water Box and Baffled for Maximum Cooling
Condensate Trays
Condensate Seal Maintains Inlet Steam Pressure in the Hotwell
Openings in Baffles for Condensate Drainage
Hotwell Vented to Air Cooler Entrance Lane
Separable Hotwell
High Condensate Temperature
Condensate Reheated and Deaerated while Cascading through Perforated Trays
Hotwell Capacity for all Condensate Produced in One Minute at Full Load
Gage Glass Standard Equipment
Pump Suction
Pump Suction
Baffles to Prevent Swirls

Ross Type "A", Twin Bank, Balanced Flow Surface Condenser

The facts and figures on Ross Surface Condensers are impressive. It will be time well spent to have a Kewanee-Ross representative tell you *all* about the design features and distinct advantages of this truly modern line.

Long a leader in the field, the originator of such noteworthy developments as all-welded steel surface condenser construction, Kewanee-Ross is in a key position to meet your requirements *exactly* with standardized or special, large or moderate size, or packaged units.

For the complete story—at your desk—write today.

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DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
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Only Permutit provides UNDIVIDED RESPONSIBILITY

–for both Ion Exchangers and Equipment

PERMUTIT ION EXCHANGERS and Equipment have improved processing and cut costs in many industries. Successful applications include copper and zinc recovery from textile wastes, metal recovery from plating wastes, purification of sugar, amino acids, antibiotics.

Permutit will help you to choose the one combination of ion exchange materials and equipment most efficient for your particular set of operating conditions . . . provide a single responsibility for *complete* plant performance. For only Permutit designs and produces the equipment and accessories as well as all types of ion exchange materials.

☑ **PERMUTIT ION EXCHANGERS**—Rigid quality control gives you a reliable product that equals or exceeds ratings. Each must pass thorough laboratory and field tests before volume production.

☑ **ION EXCHANGE EQUIPMENT**—Correct design of equipment is just as essential as selection of the proper ion exchangers. Permutit equipment is built for economy of operation with minimum maintenance. Automatic controls give uniform results, save chemicals and labor.

☑ **APPLICATION INFORMATION**—Permutit's research files contain data on all types of applications. Your inquiry will be carefully studied by experienced specialists whose recommendation will save you valuable time in planning process improvements.

Write today, outlining your problem.
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Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

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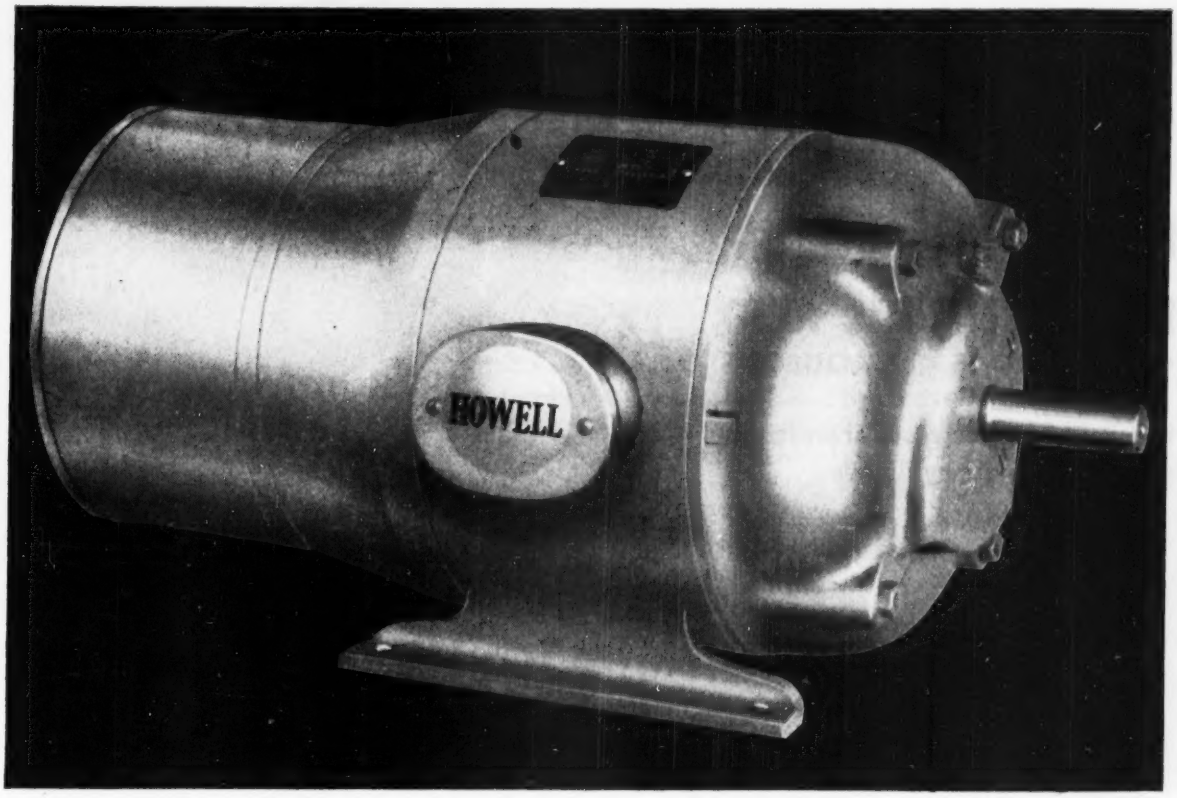
MANUFACTURER OF ION EXCHANGERS AND EQUIPMENT FOR OVER 40 YEARS



HOWELL BRAKE MOTORS

For sudden stopping, quickly and surely—there's a Howell Brake Motor that fits your exact needs!

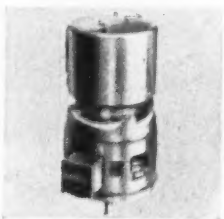
The Howell Brake Motor is designed for use in those applications where rapid stopping of rotation is required. Howell Brake Motors are used extensively on such machines as lathes, planers, drill presses and dumbwaiters.

Quick stoppage can be accomplished on motors of all types in most sizes. Brakes are of standard construction for long life and trouble-free operation.

Howell Disc Brakes are integrally mounted, simple in design, easily accessible and quickly adjusted. For complete details on using Howell Brake Motors in your operation, contact the Howell man in your area, or write the factory for Bulletin BR-1 and further information.

Three types of Howell Brake Motors

Howell General Purpose, Dripproof, Horizontal Motor (Type SC) for wall mounting, with integrally-mounted disc brake.



Howell Vertical Face-Mounted Motor with 50 ft.-lb. brake. Howell Brake Motors fit a wide variety of applications.

Howell Special Horizontal Flange-Mounted Pancake Motor with 3 ft.-lb. brake. This streamlined motor is unusually compact.

HOWELL Red Band MOTORS

HOWELL MOTORS

HOWELL ELECTRIC MOTORS COMPANY, HOWELL, MICHIGAN

PRECISION-BUILT MOTORS FOR INDUSTRY SINCE 1915

HARSHAW FLUORIDES WORK

like magic

BORON TRIFLUORIDE

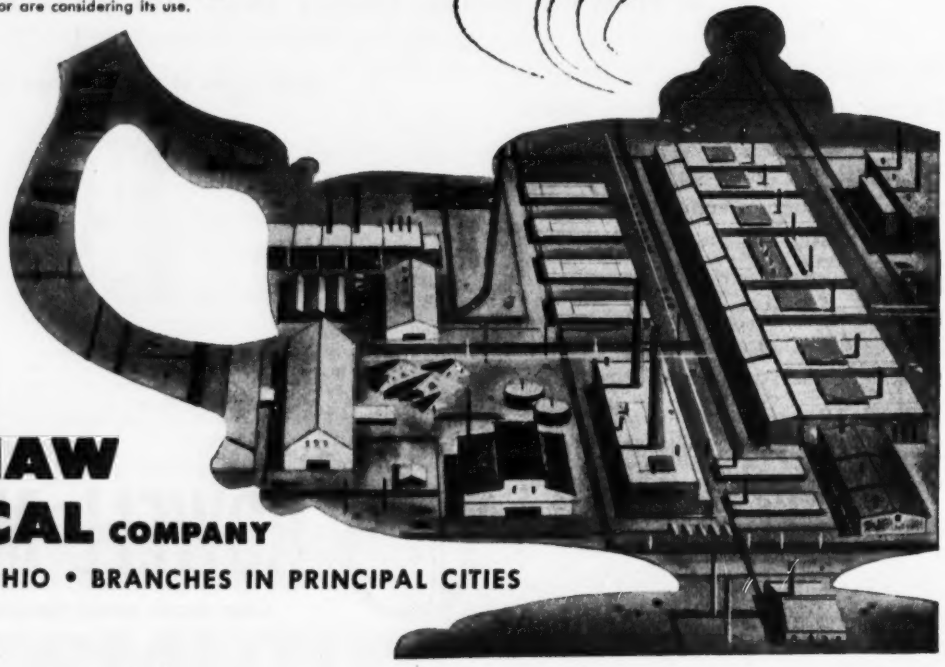
HYDROFLUORIC ACID

• ANHYDROUS • AQUEOUS

Here is an additional group of production-controlled, high-quality fluorides:

- Ammonium Bifluoride
- Ammonium Fluoborate
- Antimony Trifluoride Sublimed
- Barium Fluoride
- Bismuth Fluoride
- Boron Trifluoride
- Boron Trifluoride Complexes
- Chromium Fluoride
- Copper Fluoborate
- Fluorboric Acid
- Fluorine Cells
- Fluorinating Agents
- Frosting Mixtures
- Hydrofluoric Acid Anhydrous
- Hydrofluoric Acid Aqueous
- Hydrofluosilicic Acid
- Lead Fluoborate
- Metallic Fluoborates
- Potassium Bifluoride
- Potassium Chromium Fluoride
- Potassium Fluoborate
- Potassium Fluoride
- Potassium Titanium Fluoride
- Silico Fluorides
- Sodium Fluoborate
- Tin Fluoborate
- Zinc Fluoborate
- Zinc Fluoride

Write for Harshaw's 40-page Book on Hydrofluoric Acid Anhydrous. It provides helpful data for you if you now use HF or are considering its use.



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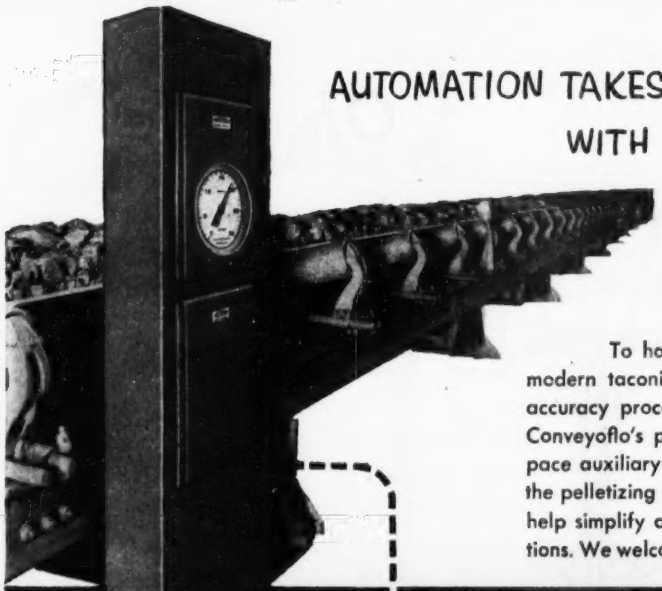
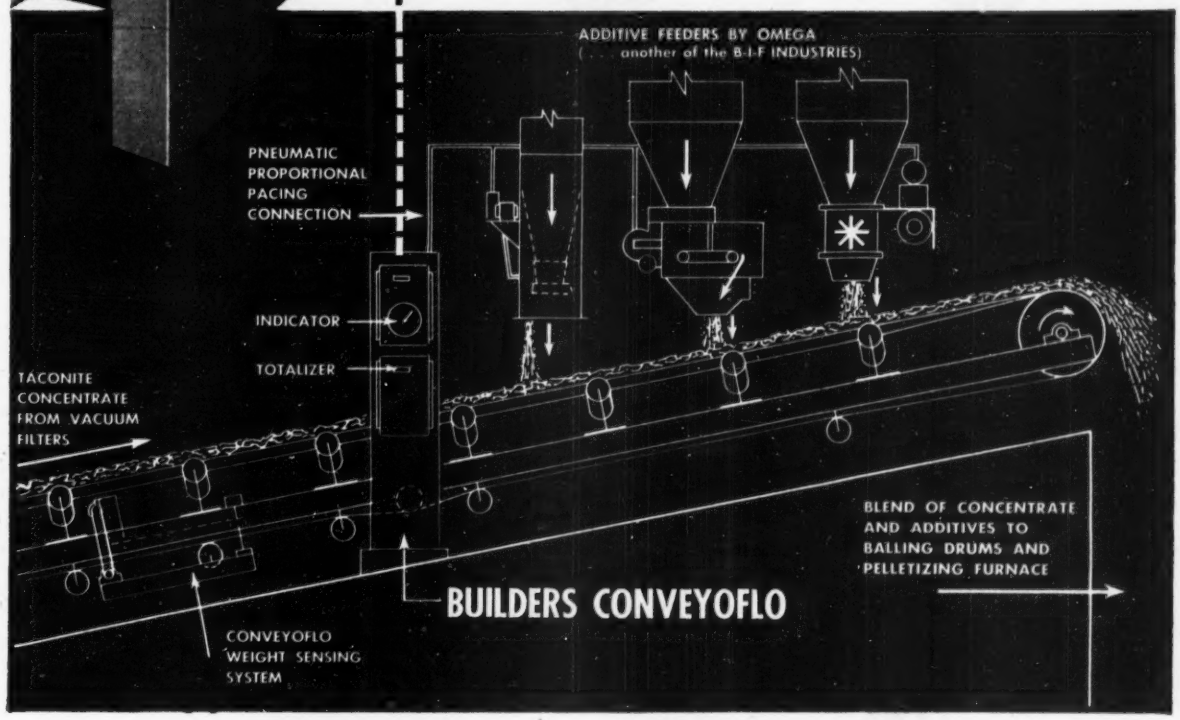
CLEVELAND 6, OHIO • BRANCHES IN PRINCIPAL CITIES

AUTOMATION TAKES OVER TACONITE PROCESSING

WITH . . . **BUILDERS CONVEYOFLO**



To handle the millions of tons of ore processed in the modern taconite plant requires the latest in high-speed, high-accuracy processing equipment. See in this flow diagram how Conveyoflo's pneumatic weight sensing system is ready-built to pace auxiliary additive feeders to produce the proper blend for the pelletizing process. Then see for yourself how Conveyoflo can help simplify and systematize your continuous processing operations. We welcome your inquiry.


ADDITIVE FEEDERS BY OMEGA
(. . . another of the B-I-F INDUSTRIES)
PNEUMATIC PROPORTIONAL PACING CONNECTION
INDICATOR
TOTALIZER
TACONITE CONCENTRATE FROM VACUUM FILTERS
BLEND OF CONCENTRATE AND ADDITIVES TO BALLING DRUMS AND PELLETIZING FURNACE
BUILDERS CONVEYOFLO
CONVEYOFLO WEIGHT SENSING SYSTEM

CONVEYOFLO FEATURES

- **ACCURATE** . . . within ± ½ of 1% of actual weight from maximum to 50% of rated capacity; within 1% from 50% to 25% rate; within 2% from 25% to 10% of meter's rated capacity.
- **COMPACT** . . . weight sensing mechanism completely contained within conveyor structure. No overhead levers. Panel stand only 9" x 18" — may be any height.
- **AUTOMATIC TOTALIZER COMPENSATION** for variations in belt speed and changes in belt weight.
- **RESPONDS ACCURATELY** to rapid load variations.
- **PACES AUXILIARY EQUIPMENT** (feeders, controllers, continuous blending processes, etc.) and operates secondary totalizers, indicators, recorders.

SEND FOR DETAILS

Builders-Providence, Inc. — Pioneers in meters and controls
(Division of B-I-F Industries, Inc.)
369 Harris Ave., Providence 1, R. I.

Please send Bulletin 550-H4A describing Builders Conveyoflo Meter.

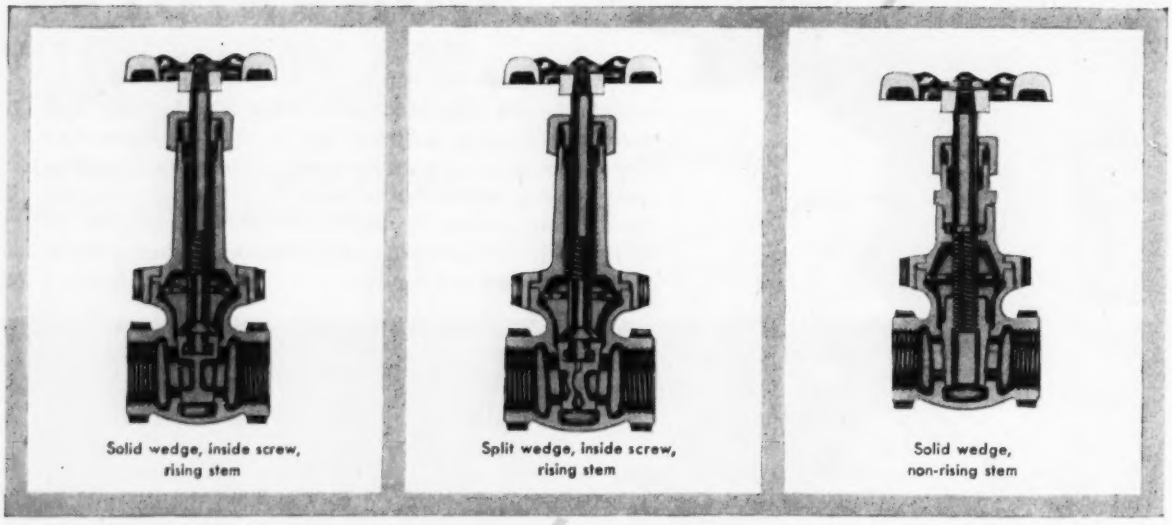
Name .....

Company .....

Street .....

City ..... State .....

Oh, I see



. . . we've added 125 and 150 lb. bronze gate valves to our union bonnet line

WORKING PRESSURES
125 lb. W. S. P. 400° F.
150 lb. W. S. P. 400° F.

Success of our 200 lb. line of union bonnet bronze gate valves necessitates expansion of the line to include 125 lb. and 150 lb. classes. Sizes range from ¼ to 2 inches.

NOTE THESE ENGINEERING FEATURES:

This line has a flat seat on the bonnet which mates against the body, providing adequate bearing area for sealing.

Tight bonnet joint, but easy access to interior for inspection and service.

Full ports permit unobstructed flow.

Back-seating arrangement permits repacking while under pressure.

Split wedge has ball in socket contact . . . permits wedge to adjust itself to seat.

Slip-on type "T" head stem-to-wedge connection.

Lug-type hexes make valves compact and provide a better wrench-gripping surface.

To learn more about this expanding line of valves, write for our *Union Bonnet Bronze Gate Valve Catalog Folder.*

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC
FOUNDED 1889

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

Celanese* METHANOL

Celanese provides a uniform basic material with a purity not less than 99.85% Methanol

...the dependability of continuous volume petrochemical production utilizing abundant resources of natural hydrocarbons

...a nation-wide distribution system that includes bulk stocks in conveniently located terminals to assure rapid delivery

...the benefit of minimum inventory at minimum prices through combination shipments in compartmented tankcars, tank-trucks, or mixed drum carloads, with other Celanese Solvents, Plasticizers and Intermediates

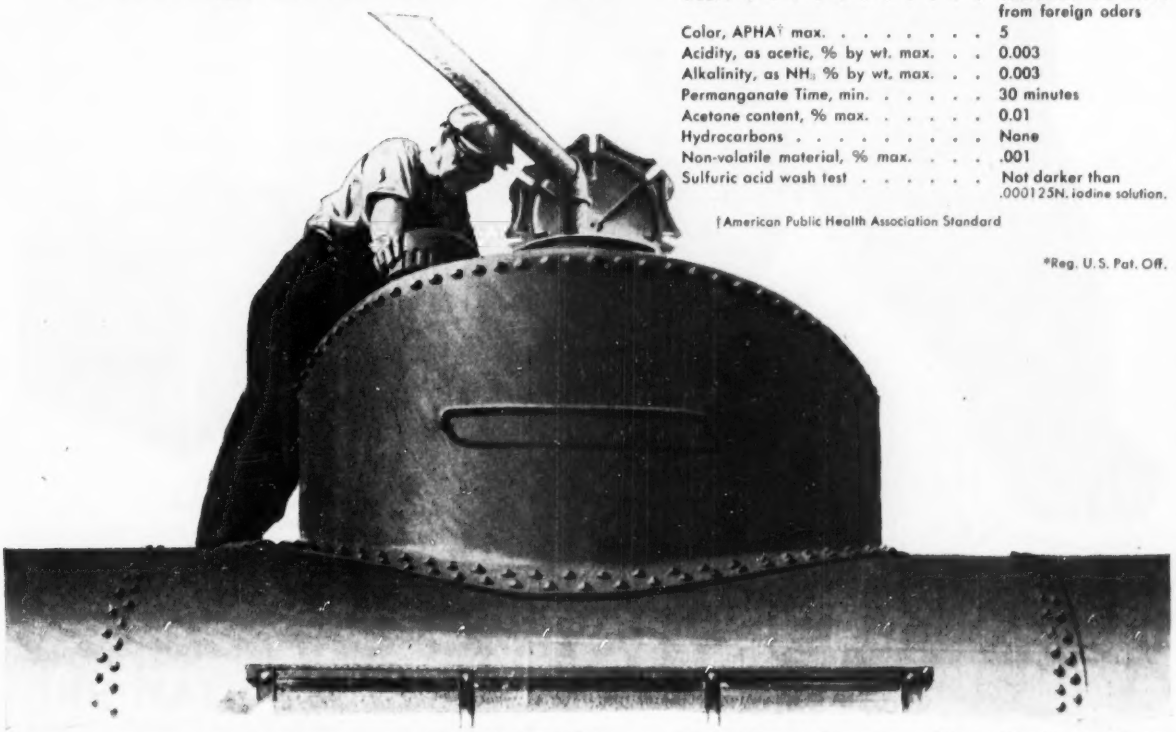
...and the Technical Service and Applications Laboratories that can help to solve many raw material problems.

Celanese Specifications

Methanol Content, % min.	99.85
Specific Gravity, max. @ 15/4°C	0.7962
Distillation Range, °C max.	1.0
Appearance	Clear and free of suspended matter in transmitted light
Odor	Characteristic and free from foreign odors
Color, APHA† max.	5
Acidity, as acetic, % by wt. max.	0.003
Alkalinity, as NH_3 % by wt. max.	0.003
Permanganate Time, min.	30 minutes
Acetone content, % max.	0.01
Hydrocarbons	None
Non-volatile material, % max.	.001
Sulfuric acid wash test	Not darker than .000125N. iodine solution.

†American Public Health Association Standard

always on stream



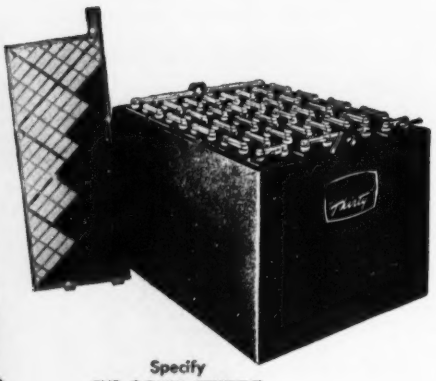
*Reg. U.S. Pat. Off.

Celanese Corporation of America • Chemical Division • 180 Madison Avenue • New York 16, N. Y.

Plenty of Reserve Strength

THANKS TO BATTERY POWER!

There's nothing like battery power for rough, tough industrial truck service. Only battery power gives you the extra reserve to meet the stringent demands for higher lifts, faster maneuvering and continuous all-day operation. And the Gould "Thirty" with new Diamond "Z" Grids has the unique features of design that give you extra battery performance and longer battery life . . . make your trucks work harder and longer.



Specify
THE GOULD "THIRTY"
with New Diamond "Z" Grids—
America's Finest
Industrial Truck Battery

GOULD INDUSTRIAL BATTERIES

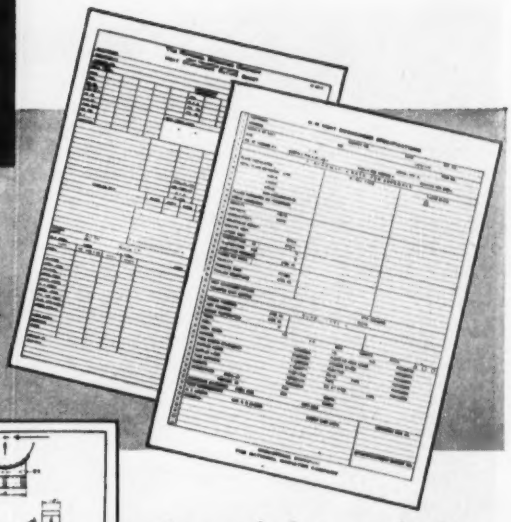
GOULD-NATIONAL BATTERIES, INC., TRENTON 7, N. J.

Always Use Gould-National Automobile and Truck Batteries

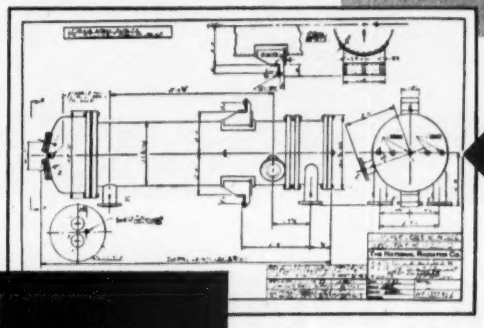
©1954 Gould-National Batteries, Inc.

NATIONAL

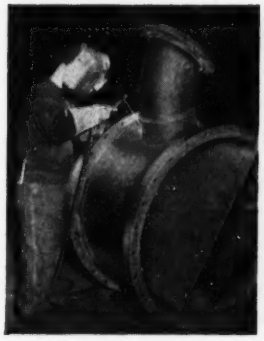
SHELL and TUBE HEAT EXCHANGERS

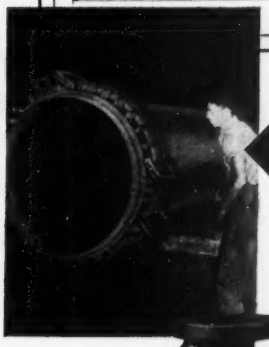


Your heat exchanger problems will be handled completely and efficiently from individual specifications . . .



through latest design to highest standards





and careful fabrication . . .

to finished product

WRITE FOR BULLETIN HT-654.

NRC

WE WELCOME YOUR INQUIRIES!

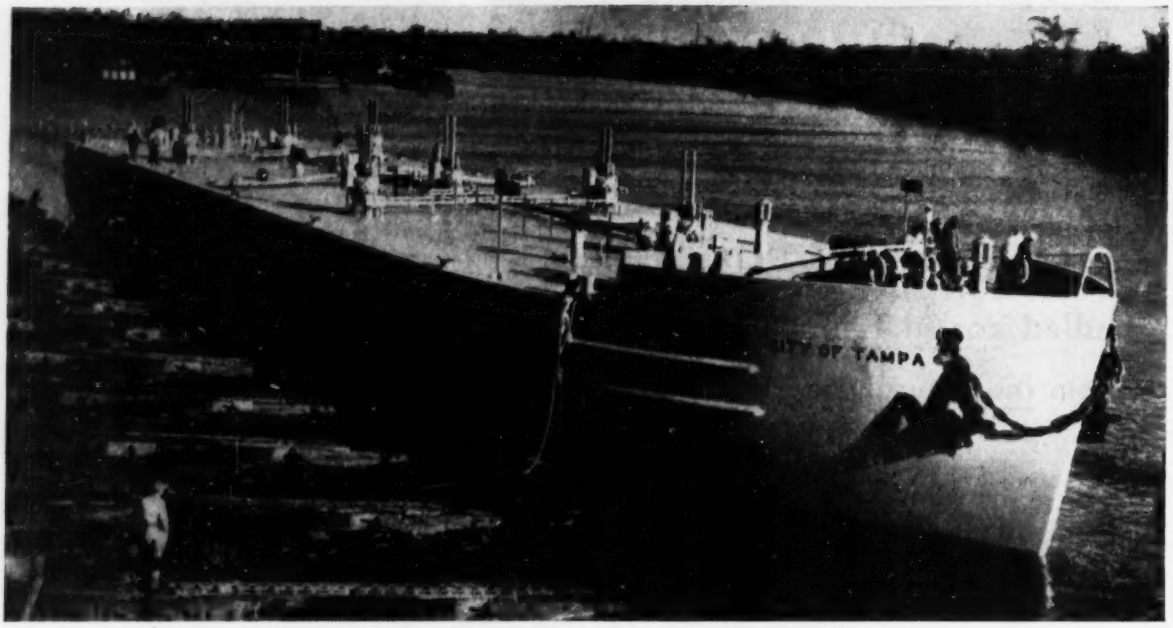
by the *Heat Transfer Division* of

THE NATIONAL RADIATOR COMPANY

JOHNSTOWN, PENNSYLVANIA

HEAT TRANSFER DIVISION HEADQUARTERS 60 East 42nd Street, New York

Bethlehem at Beaumont



Easy-towing lines of this deepwater barge were developed from model tank tests.

FIRST OCEANGOING AND LARGEST LIQUEFIED PETROLEUM GAS BARGE

The *City of Tampa*, recently constructed by Bethlehem at Beaumont for Warren Petroleum Corp., is the first deepwater and largest L.P.G. barge ever built.

242 ft long, 48 ft wide and 17½ ft deep, this all-welded, longitudinally-framed craft has seven tanks of 250-lb working pressure with a combined capacity of 500,000 gallons of L.P.G.

Designed jointly by Bethlehem and Warren and constructed to the highest requirements of the U. S. Coast Guard and the American Bureau of Shipping, the *City of Tampa* represents another important development in the safe, speedy and economical transportation of Liquefied Petroleum Gas.

L.P.G. CARRIERS
Built or Converted by BETHLEHEM at BEAUMONT

S.S. NATALIE O. WARREN
Water Capacity 38,000 bbls

S.S. ULTRAGAZ
Water Capacity 17,100 bbls

CITY OF MOBILE
CITY OF LAKE CHARLES
River barges. Water capacity 360,000 gallons

PANAMA CITY
River barge. Water capacity 393,000 gallons

CITY OF TAMPA
Deepwater barge. Water capacity 550,000 gallons

ESSOLITE II
Deepwater barge. Water capacity 220,000 gallons

SHIP REPAIR YARDS

Boston Harbor — New York Harbor
Baltimore Harbor — Beaumont, Texas
Los Angeles Harbor — San Francisco Harbor

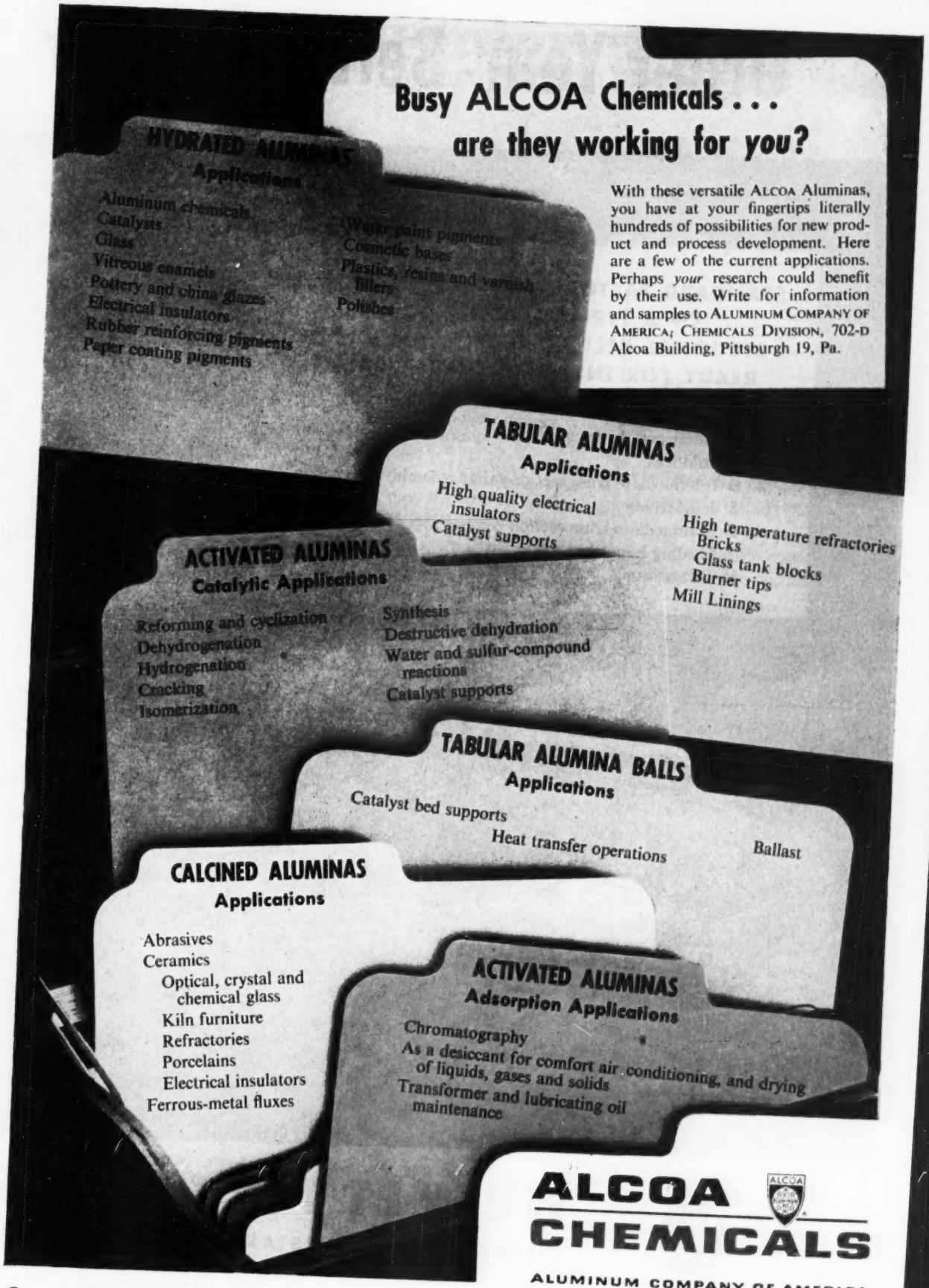
SHIPBUILDING YARDS

Quincy, Mass. — Staten Island, N. Y.
Sparrows Point, Md. — Beaumont, Texas
Terminal Island, Calif. — San Francisco, Calif.

BETHLEHEM STEEL
Shipbuilding Division

GENERAL OFFICES: 25 BROADWAY, NEW YORK 4, N.Y.

On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation


Busy ALCOA Chemicals . . .
are they working for you?
With these versatile ALCOA Aluminas, you have at your fingertips literally hundreds of possibilities for new product and process development. Here are a few of the current applications. Perhaps your research could benefit by their use. Write for information and samples to ALUMINUM COMPANY OF AMERICA; CHEMICALS DIVISION, 702-D Alcoa Building, Pittsburgh 19, Pa.
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Destructive dehydration
Water and sulfur-compound reactions
Catalyst supports
TABULAR ALUMINA BALLS
Applications
Catalyst bed supports
Heat transfer operations
Ballast
CALCINED ALUMINAS
Applications
Abrasives
Ceramics
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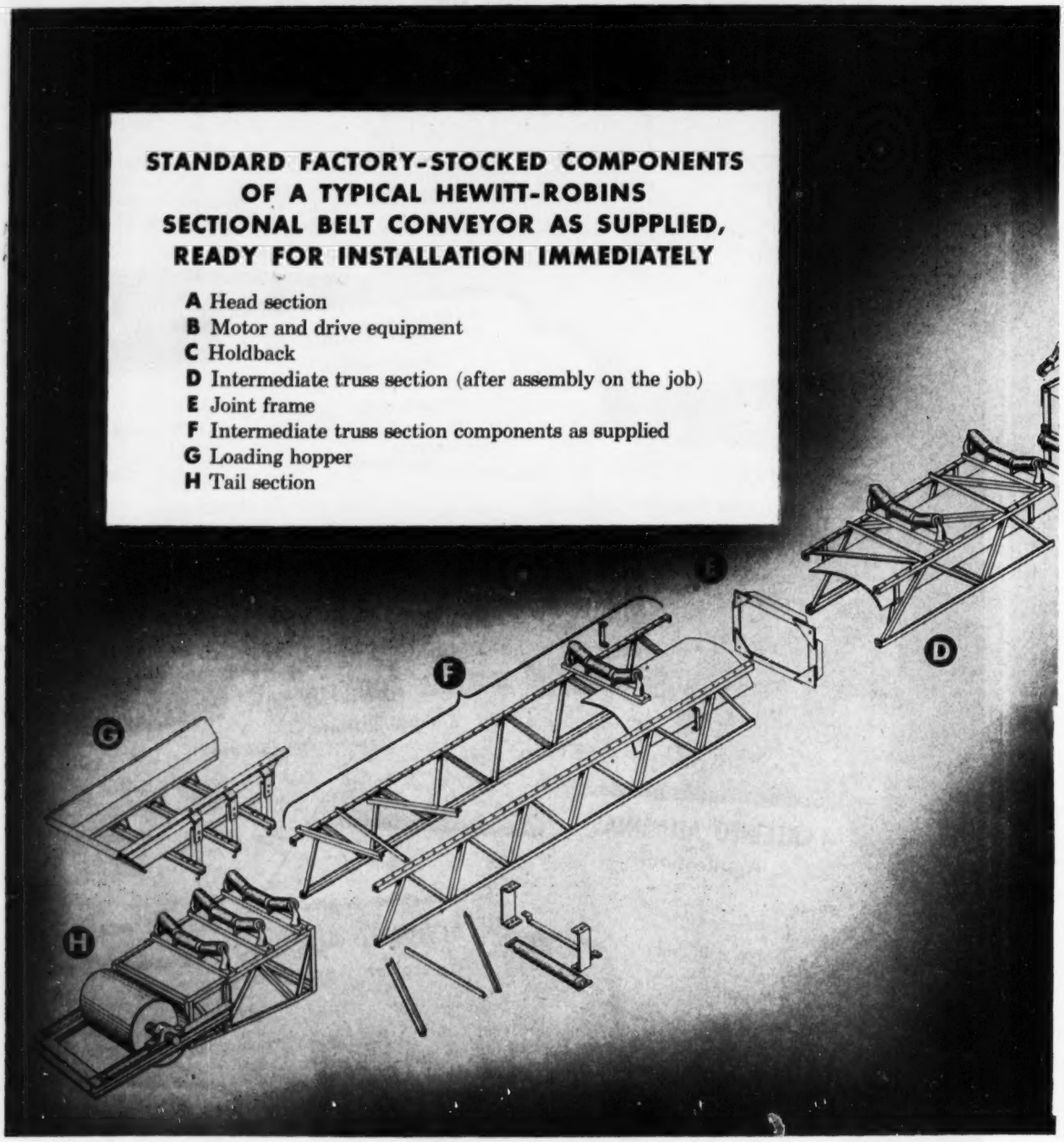
Kiln furniture
Refractories
Porcelains
Electrical insulators
Ferrous-metal fluxes
ACTIVATED ALUMINAS
Adsorption Applications
Chromatography
As a desiccant for comfort air conditioning, and drying of liquids, gases and solids
Transformer and lubricating oil maintenance
ALCOA
CHEMICALS
ALUMINUM COMPANY OF AMERICA

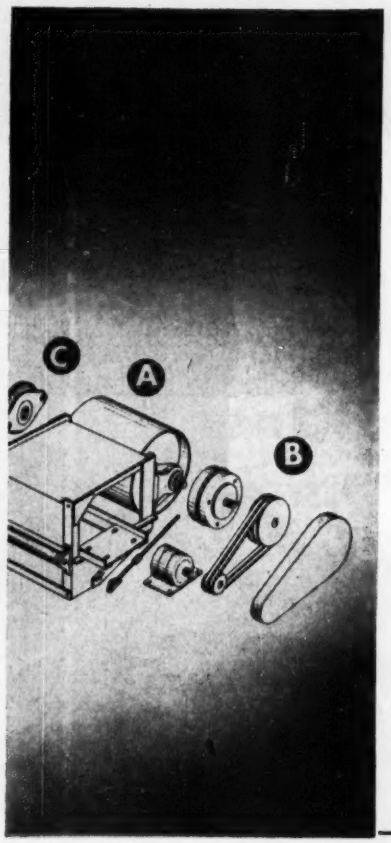
Order Your Belt Conveyor



HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

Right From Factory Stock



Save Time and Money . . . Install your own Hewitt-Robins Sectional Belt Conveyor from Easy-to-assemble Factory-built Components

Now, for the convenience of large and small plant operators alike—Hewitt-Robins offers a standardized sectional conveyor adaptable to a wide variety of uses.

Hewitt-Robins Sectional Conveyors consist of completely assembled factory-stocked components that can be quickly and economically installed and maintained by your own personnel.

When you order a Hewitt-Robins Sectional Conveyor you can be sure of prompt delivery . . . all components and parts from machinery to belting are shipped to you direct from standard factory stocks . . . saves you time and saves you money.

For prompt information about the Sectional Conveyor and any other Hewitt-Robins bulk material handling products, contact the Hewitt-Robins office nearest you or write direct to Passaic, New Jersey.

ENGINEERING DATA

APPLICATION: Designed to handle bulk and packaged materials where special limitations and conditions do not require the use of custom-engineered belt conveyors.

MATERIALS HANDLED: Sand, gravel, run-of-mine ore, coke, stone, coal, gypsum, grain, sugar beets and any other bulk materials that can be handled more efficiently and economically by belt conveyor.

CAPACITIES: From 20 to 500 TPH at belt speeds from 200 to 450 feet per minute.

STANDARD WIDTHS: 18", 24", 30", 36".

LENGTH: From 15'6" up to any length consistent with good conveyor practice . . . inclines up to 22½°.

STANDARD HORSEPOWER: From 2 to 30 hp.

IDLERS: 4" or 5" diameter troughing and return idlers available. Both types have exclusive Hewitt-Robins patented Triple Grease Seal and one-shot lubrication.

BELTING: Complete selection of all Hewitt-Robins standard stocked belts. Special belts available when necessary.

INSTALLATION: All standard factory-assembled components are clearly labeled and shipped with complete instructions, for quick, easy assembly by your own personnel.

Write for Bulletin #132-B on your company letterhead

Here is a partial list of **HEWITT-ROBINS PRODUCTS** *that will help you cut handling costs and increase operating efficiency*

MACHINERY:

- Belt Conveyors
- Belt & Bucket Elevators
- Car Shakeouts
- Screen Cloth
- Vibrating Conveyors & Screens

INDUSTRIAL RUBBER PRODUCTS:

BELTING:

- Conveyor
- Elevator
- Transmission

HOSE:

Hewitt-Robins makes over 1,000 different types of industrial rubber hose, including Twin-Weld®, the patented twin-line welding hose.

For information and service on industrial rubber products, contact your Hewitt-Robins Industrial Supply Distributor. Through his complete stock of Hewitt-Robins Rubber Products, and his familiarity with local field conditions, he can fill your supply needs promptly and correctly. See Classified Phone Book for the Hewitt-Robins Industrial Supply Distributor serving your area.

3081

INCORPORATED

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam

FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • **EXPORT DEPARTMENT:** New York City.

Keys to efficient production

Frequently the keys to more efficient production are found in more reliable chemicals.

This is one reason why more and more users of chemicals are turning to Niagara.

a case in point...

NIALK CAUSTIC POTASH: The production of new and improved types of synthetic rubber requiring potash soaps has led to an increasing demand for NIALK Caustic Potash because its soaps are more soluble than comparable soda soaps, and less viscous at the same solids concentration.

Constant research, strict quality control and a knowledge of the needs of industry have made this and other NIALK products leaders in their fields.

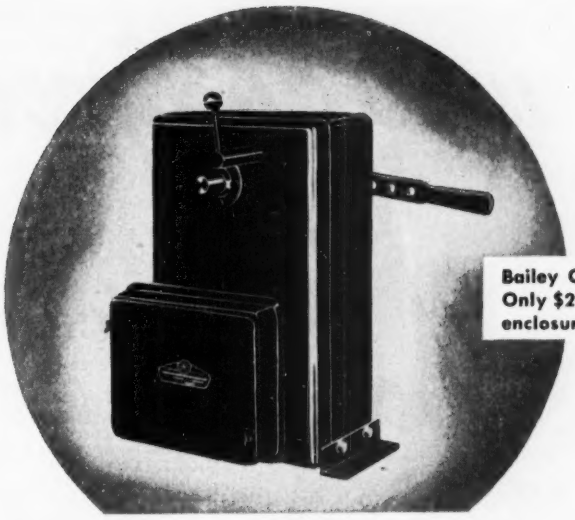
NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

Nialk

LIQUID CHLORINE
CAUSTIC POTASH
CARBONATE OF POTASH
PARADICHLOROBENZENE
CAUSTIC SODA
TRICHLORethylene

NIAGATHAL (TETRACHLORO PHTHALIC ANHYDRIDE)



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

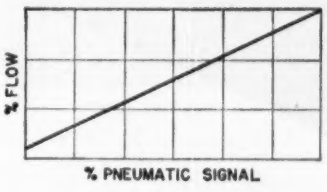
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

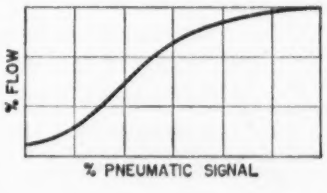
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



BAILEY METER COMPANY

1054 IVANHOE ROAD

CLEVELAND 10, OHIO

Complete Controls for Process Plants

BAILEY METERS

Controls for

TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

FOR MORE INFORMATION

FILL OUT AND MAIL

☐ I am interested in Bailey Control Drives. Mail me Spec. CA048.

☐ I am interested in Bailey Control Linkage. Mail me Spec. CA942R.

Name

Title & Company

Street & Number

City & Zone State

since 1949 / Glycerine is the Demulcent

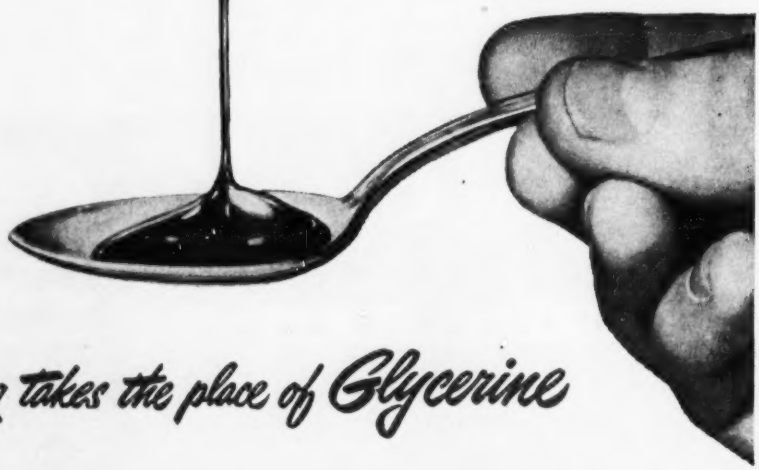
Vicks Cough Syrup is a staple in medicine cabinets all over the world. Its popularity is due in part to the U.S.P. Glycerine contained in the basic formula. Besides making Vicks a more palatable liquid which can be tolerated by children of all ages, Glycerine provides the cough syrup with demulcent and expectorant qualities.

Glycerine is an ideal ingredient for many internal medicines. One important reason is the fact that U.S.P. Chemically Pure Glycerine is non-toxic. It is accepted by medical associations and government agencies as safe for human consumption.

Several other major properties of Glycerine are also important in such uses. In cough syrup for example, it acts as a demulcent, expectorant, dispersing or suspending agent, and sweetener, and adds body to the preparation.

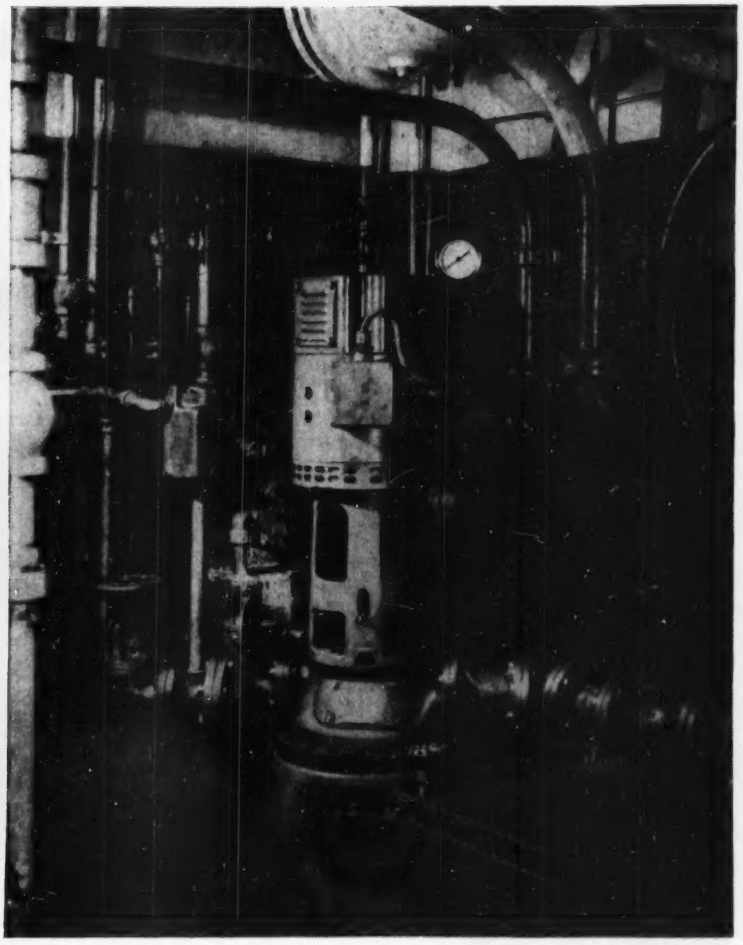
Glycerine is also an important ingredient in many confections, flavoring agents, and other food products.

To get the complete story on why there's no single substitute that combines all of Glycerine's physical and chemical properties, write for your free copies of "Why Glycerine for Foods?" and "Why Glycerine for Drugs and Cosmetics?" Address Glycerine Producers' Association, 295 Madison Avenue, New York 17, New York.



Nothing takes the place of Glycerine

Unique Problem– Common Solution



Although this LaBour pump (and another just like it) aren't at work in the chemical industry, their unusual application is of interest because it proves what we've been saying all along. Competent engineers naturally turn to LaBour.

The two LaBour pumps are installed on opposite sides of the motorship *Wards Island*, a sludge disposal vessel owned by the New York City Department of Public Works. The pumps circulate sea water for cooling the diesel engines. Either pump may lose prime as the vessel rolls, but must pick up immediately as the roll reverses so it will be supplying water when the other pump loses prime.

Failure of the system to operate as planned could result in costly damage to the engines. So the marine engineers responsible, like their brothers in the chemical industry, specified the pumps known for dependability—LaBour. The LaBour Type BG pumps prime quickly as called upon, and everybody's happy.

It's a fact that no engineer, marine or chemical, has ever had cause to regret that he specified LaBour. That's why so many top men seldom specify anything else.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

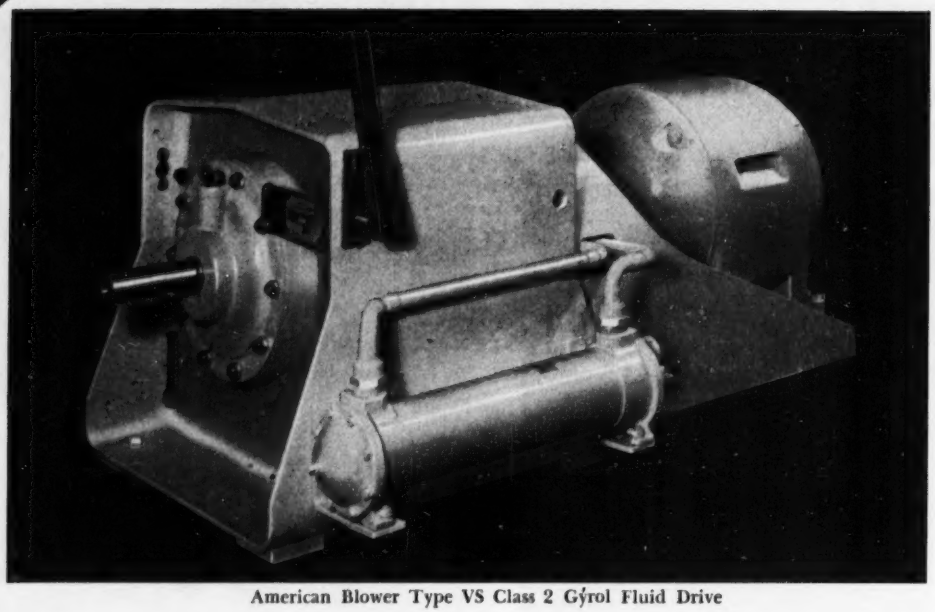
LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.

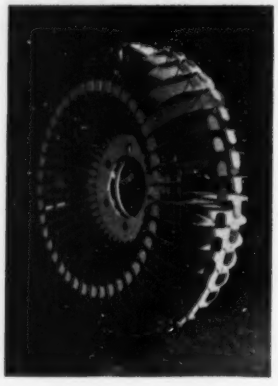
ANNOUNCING THE NEW AMERICAN BLOWER

Gýrol FLUID DRIVE

TYPE VS CLASS 2



American Blower Type VS Class 2 Gýrol Fluid Drive



A phantom view of the driving and driven members, which provide smooth, reversible power transmission.

- **Can be reversed while in motion at any variable operating speed by merely reversing direction of rotation of motor**
- **Permits adjustable speed control over a wide range**
- **Built in several standard arrangements**

HERE IT IS! A brand-new fluid drive that will help you solve many tough industrial-drive problems. It's the American Blower Type VS Class 2 Gýrol Fluid Drive. A compact, self-contained, adjustable speed unit.

The result of years of development and research, this adjustable-speed fluid coupling is crammed with features. It has unlimited application possibilities, with its wide-range, stepless speed, reversible control. Even on constant-torque loads, a 4-to-1 speed range is obtainable!

It permits driving motors to reach full-load speed before engaging the load. In many cases simple across-the-line starting may be used. Adjustable speed may be obtained by either automatic or manual adjustment of the speed-control lever.

The new Type VS Class 2 Gýrol Fluid Drive is available in six sizes . . . 7½ through 800 h.p., at normal motor speeds up to 1800 r.p.m. Built in five standard arrangements, it can be used on a wide variety of industrial applications.

For complete information about the Gýrol Fluid Drive line, give your nearest American Blower Branch Office a call, or write us direct for free literature.

For smaller applications the Type TM Constant Speed Gýrol Fluid Drive is available in ratings from 1 to 20 h.p.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

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Unretouched View of an Irrigated Tower Section Photographed [illegible] Tower.

Examine the photograph above. Note that no two or three pieces of Intalox "nest" into one another like this))))) . The closest they can come to nesting is this ⋑⋑. Result: no pattern packing . . . no blocking or screening of large areas of packing surface.

This greater degree of randomness in a packed bed, coupled with greater surface area per nominal sized unit means more free space, and more surface area available to liquor and gas. As a result pressure drop is substantially lower, flooding limits measurably higher — all around tower efficiency in terms of output and cost markedly improved.

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358 D

TYPICAL DATA ON INTALOX* SADDLE PACKING

Nominal Size, Inch	Approximate Number per Cu. Ft.	Approximate Weight per Cu. Ft., Lb.	Approximate Surface Area Sq. Ft./Cu. Ft.	Percent Free Gas Space	Equivalent Spherical Diameter Dp, Inch
¼	117500	42	300	75	0.20
½	20700	34	190	78	0.32
¾	6500	35	102	77	0.48
1	2385	34	78	77.5	0.68
1½	709	30	59.5	81	0.96
2	265	33	36	79	1.38

**Trade name, The U. S. Stoneware Co.*

THE Chementator®

Prepared under the direction of Joseph A. O'Connor, News Editor

• General Aniline & Film plans to build a multi-million dollar plant at Calvert City, Ky., to produce acetylene derivatives. GAF will get its acetylene from National Carbide, an Air Reduction subsidiary, which has a plant at Calvert City making acetylene from calcium carbide. GAF's requirement: an estimated 15 million pounds per year of acetylene.

• Atomic energy is becoming an important part of the business of International Minerals & Chemical. Now producing byproduct uranium in its new phosphate plant near Bartow, Fla., it may later become a producer of lithium.

Cooling acetylene by water injection

Allis-Chalmers is building a number of five-stage 10,920-cfm. centrifugal compressors to handle acetylene in a new acrylonitrile plant. Unique feature of these compressors: water will be injected at each of the five stages to keep the temperature of the acetylene mixture in the process below 200 deg. F. at all points in the compressor. In addition, the performance of the compressor will be improved.

Driven by 1,360-hp. turbines, the compressors will provide a pressure increase of about 35 psi. in the gas stream.

Making use of the heat of vaporization provided by injecting water into the gas stream, according to Allis-Chalmers engineers, offers more than a thousandfold increase in the cooling ability of water compared with that available when water is circulated through a cooling jacket heat exchange system.

Previous experience with water injection in a compressor built for handling CO_2 assured Allis-Chalmers engineers that the method was practical if metallurgical considerations were taken into account. Final test results on the compressors won't be available until they go into service later this year. It's expected that the new compressors with water-injection cooling will find use in other plants manufacturing or processing acetylene.

New producer of synthetic mercaptans

Successfully producing mercaptans by its own synthetic process, Index Chemical Co. recently shipped its first tank car of methyl mercaptan from its plant on Greens Bayou near the Houston Ship Channel. Index is also producing ethyl mercaptan, and has developed a process for the manufacture of other mercaptans.

At present both methyl and ethyl mercaptan are being produced commercially. These mercaptans sell at 25 to 40 c. per lb. in tank-car quantities. Index is the only producer for sale of methyl mercaptan by a synthetic process, and the only producer of ethyl mercaptan for any purpose by synthesis.

Index also has a process for the production of such organic sulfides as dimethyl sulfide, methyl ethyl sulfide and diethyl sulfide. As solvents, these chemicals can be used where odor is no drawback. They can be produced to sell at fairly low prices.

Organized only a year ago, Index Chemical, with headquarters in Houston, Tex., is headed by President Edward Lewis. This new producer of synthetic mercaptans has already found one important outlet for its methyl mercaptan.

Coal carbonization at low temperature

United Engineers & Constructors Inc. has constructed a pilot plant in Philadelphia for the low-temperature carbonization of coal. It starts operating this month.

The pilot plant, with a capacity of 2 tons per day, will carbonize coking and non-coking coals in a fluidized-bed process. Not strictly a prototype unit, the pilot plant is designed to evaluate coals and produce liquid products.

Most important unknown in low-temperature carbonization, according to United Engineers & Constructors, is the economic potential of the liquid products. The pilot plant will produce enough of these

(Continued on page 106)

liquid products for an evaluation to be made. It will also make sufficient char for investigation of metallurgical coke blending, combustion and gasification.

Dimethyl terephthalate by air oxidation

For the first time, dimethyl terephthalate will be produced by a new air oxidation process in a $4 million plant at Burlington, N. J., now being built by Hercules Powder Co. The plant will supply DMT for the manufacture of polyethylene terephthalate fiber in a new $22 million plant of Imperial Chemical Industries of Canada Ltd. at Millhaven, Ontario.

Initially, the annual capacity of the new Hercules plant will be 12 million pounds. But this can be increased as other markets open for dimethyl terephthalate. Hercules, which will supply producers of ICI's Terylene fiber in foreign countries, also foresees substantial demand for uses other than synthetic fibers.

Hercules expects the new DMT plant to be in operation in May 1955, a month before the ICI synthetic fiber plant. Meantime, dimethyl terephthalate produced in semi-plant facilities at Burlington, N. J., will supply the Canadian pilot plant.

The Hercules plant will be the first to manufacture dimethyl terephthalate by a new air oxidation process. The only other DMT plant in the United States utilizes a different process.

California Research Corp. has granted Hercules basic rights to the air oxidation process for producing dimethyl terephthalate in the United States. In Canada, Hercules owns exclusive rights to the Imhausen Werke process, which is the same.

The actual manufacturing process is an outgrowth of a unique method for oxidizing xylenes. Hercules plowed $1.5 million into the development of a commercial process. This required more than two years of research.

Hercules is also continuing its research and development on dimethyl isophthalate. This chemical, which has advantages in the manufacture of plasticizers, alkyds and polymers, will become available when semi-plant facilities now being used for dimethyl terephthalate are freed.

Furfural from waste sulfite liquor

Furfural is produced from waste sulfite pulping liquor in a pilot plant at Berlin, N. H., by Brown Co., a manufacturer of wood cellulose products. One objective is the reduction of stream pollution in the Androscoggin River. Another is the maximum utilization of wood, which is Brown's prime raw material.

The furfural pilot plant is located in the Burgess pulp mill adjacent to sources of raw material and power. It is operated by Brown researchers, who have already done extensive work on the production of furfural from sulfite liquor.

Making furfural is one of the more likely ways for Brown to dispose of spent liquor from its pulping operations. If the pilot plant confirms that the process is technically practical, Brown expects to build a large furfural plant.

Furfural is used in the manufacture of nylon, paints and plastic molding powders. It is also a selective solvent for the refining of petroleum, rosin and vegetable oils.

Brown hopes the market for furfural will justify the capital investment for plant facilities. In addition, according to Dr. P. M. Goodloe, assistant director of research, market outlets will be sought for the lignin products that can be made simultaneously with the furfural.

Target for Atlas: emulsifiers for foods

A brace of new esterification plants, one at Memphis, Tenn., and the other at Brantford, Ontario, are under construction by Atlas Powder Co., which is stepping up its research and selling effort aimed at the food industry. The new plants will produce fatty esters of sorbitol and glycerine for use by manufacturers in the South and in Canada as emulsifiers.

Atlas is taking advantage of the current surplus to increase its utilization of fats and oils as chemical raw materials just as it now uses sugars in the production of sorbitol. The current expansion will make Atlas a multi-plant producer of fatty esters from sorbitol and glycerine. And it means lower freight costs for users of emulsifiers in Dixie and Canada.

The Memphis plant, larger of the two, will cost more than $1 million and is slated for completion by late 1954. It will be next to the plant of HumKo Co., a subsidiary of National Dairy Products Corp. At present Atlas distributes fatty acids made by HumKo.

The second plant, at Brantford, Ontario, is being erected by Atlas Powder Co., Canada, Ltd. Its first unit, to cost about $350,000, will be operating in six months. Later, a second unit may be added to produce ethylene oxide derivatives.

The Memphis and Brantford plants will both produce emulsifiers by reacting fats and oils or fatty acids with sorbitol or glycerine. The food industry uses these products as emulsifiers. They are also used in pharmaceuticals, cosmetics, surface coatings, textiles and cleaning compounds, as well as in the production and refining of petroleum.

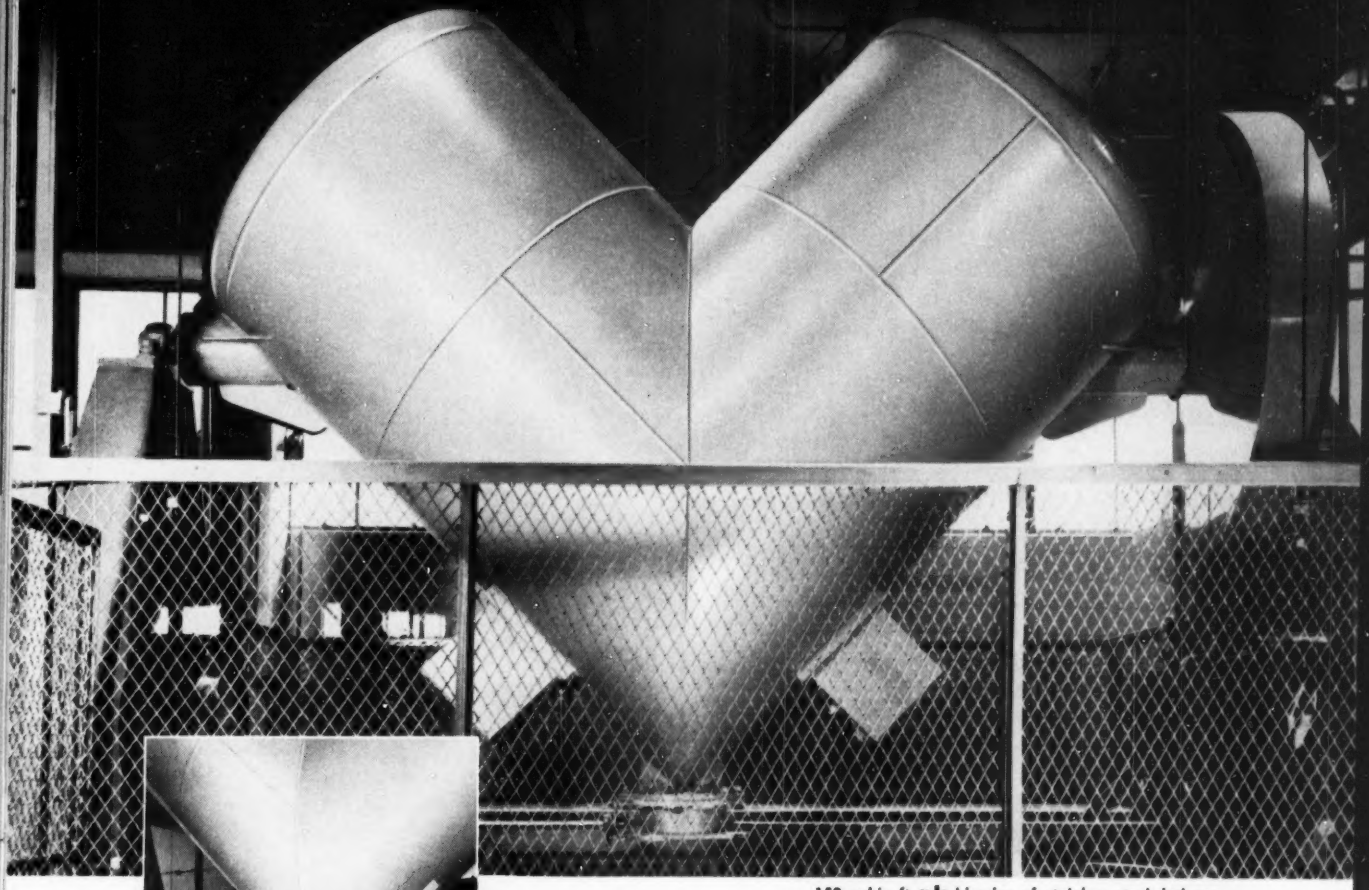
When it was foreseen that increasing demand for mono- and diglyceride emulsifiers would soon outstrip the capacity of its Atlas Point, Del., plant, Atlas decided to build the new plants at Memphis and Brantford.

Construction of these two plants will enable Atlas to produce emulsifiers at three widely separated locations with better access to markets and more flexibility in sources of raw materials. The Memphis plant,

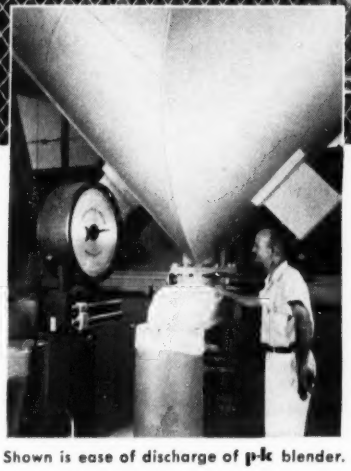
(Continued on page 110)

HOFFMANN-LA ROCHE, INC.

blends a 3-ton dose of vitamins



150 cubic ft. **p-k** blender of stainless steel-clad construction is charged through opening in floor above.



Shown is ease of discharge of **p-k** blender.

Hoffmann-LaRoche, Inc., Nutley, N. J., leading pharmaceutical manufacturers, find blending a three-ton dose of vitamins in one batch an easy matter with a **p-k** twin shell dry blender.

And, at the same time, the patented **p-k** blender provides perfect dispersion of the ingredients, as uniformly as a druggist compounds a single prescription.

The 150 cubic foot **p-k** blender shown here is at work every day in the modern Hoffmann-LaRoche plant at Nutley, N. J. Five different particle sizes are perfectly blended in 6600-lb. batches in this **p-k** blender. Clinical cleaning is easy, because of the wide openings of the **p-k** blender.

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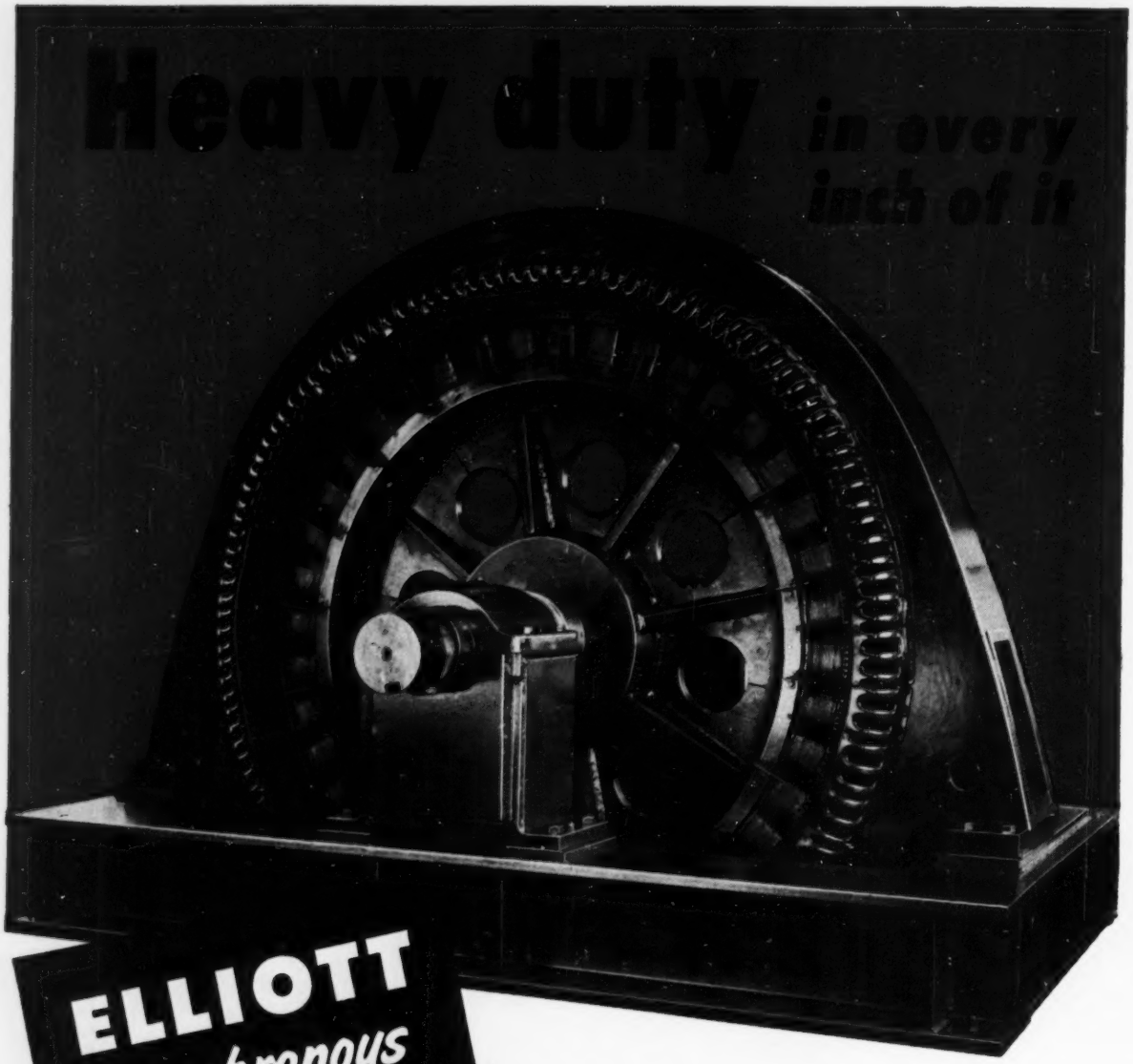

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R3-8

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Sulphuric acid plant modernizes

The Elliott motor-driven unit at the left was installed in 1948. It is rated 23,000 inlet cfm, with a differential pressure of 100 in. water. A later unit, at right, has equal capacity with a differential pressure of 130 in. water.

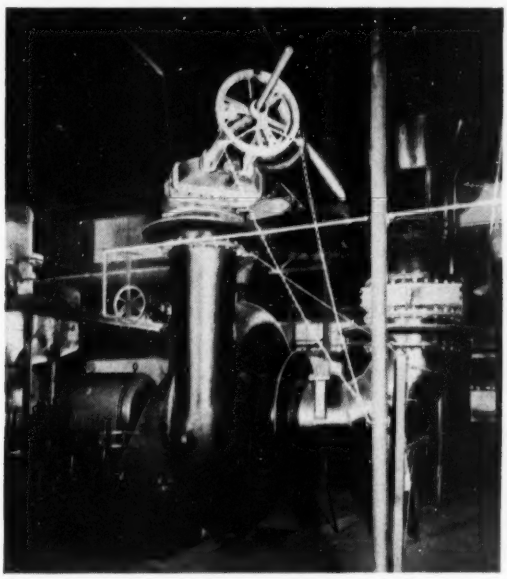

Photo above shows piping arrangement including expansion joints, shut-off valves and support for intake piping, all essential to a satisfactory blower installation.

with ELLIOTT *Centrifugal* COMPRESSORS

● In line with the majority of new sulfuric acid plants, as well as those bringing their equipment up to today's operating standards, the plant illustrated has, since 1948, installed several Elliott centrifugal blowers to replace units of positive displacement type.

These blowers must operate 24 hours per day; in fact, they are the key to the entire plant operation, actually regulating the process. In circumstances like these, the dependable performance of Elliott blowers is essential.

Elliott blowers are built complete with drive—motor or turbine—in the Elliott shops. For full details, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

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P3-4

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situated next to the plant of HumKo, one of the country's largest processors of fats and oils, will have the advantage of a close raw material source and the newest technological improvements. Canada's agriculture will furnish raw materials for the Brantford plant. These Canadian purchases by Atlas will be supplemented only when necessary by the import of specialties from world markets or from the United States. Both plants will provide faster shipment and lower freight costs to industrial markets.

Dorr designs plants for Japan and Norway

A pair of new chemical fertilizer plants, now being designed by the Dorr Co. of Stamford, Conn., when constructed will be half a world apart. Shin Nippon Chisso Hiryo K. K. plans to build a phosphoric acid and ammonium phosphate plant at Minimata, Japan, while Det Norske Zinkkompani A/S will erect a phosphoric acid plant at Odda, Norway.

Shin Nippon will produce granular ammonium phosphate using Dorr's fines recirculation system. Intermediate phosphoric acid containing 28 percent P_2O_5 will be made from various commercial phosphate rocks. Through the use of Dorr's strong phosphoric acid process no evaporation of the phosphoric acid will be required despite the use of low-grade 70 percent H_2SO_4 as a starting material.

Sanki Engineering Co., Ltd., of Tokyo initiated this project. Equipment will be supplied from the United States and Japan. Twenty-five years ago Dorr designed a similar plant for Shin Nippon. It was erected in Korea, but was completely destroyed during the recent Korean war.

The plant at Norske Zink will use phosphate rock from Morocco as raw material. It will utilize Dorr's strong phosphoric acid process and evaporation system to produce concentrated phosphoric acid for the manufacture of triple superphosphate.

Sulfur dioxide from zinc roasters will be the starting material for the production of H_2SO_4 used in the process. At present, superphosphate is the only fertilizer product of this zinc smelter. Equipment for the new phosphoric acid plant in Norway will be manufactured in Europe.

Another boost for nation's ethylene capacity

A new ethylene plant and a new platforming plant, each the largest of its kind in the world, will be erected at the Port Arthur, Tex., refinery of Gulf Oil Corp. These units will be part of a $42 million expansion at Port Arthur.

The ethylene unit will cost an estimated $12 million, the platforming unit $8 million. Another $22 million will go for a laboratory, power plant expansion and other construction at the huge refinery.

Capacity of the ethylene unit, second at the refinery, will be 3 billion cubic feet of ethylene gas per year. This will represent about a 10 percent increase in the nation's ethylene production. It will more than double the refinery's present production, lifting the total to nearly 5.5 billion cubic feet yearly.

The platforming unit is designed to produce an improved high-octane motor gasoline. It may also be used to improve and expand aviation gasoline production. Its capacity: 29,000 bbl. per stream day.

The platforming process will utilize the platinum catalyst method of Universal Oil Products Co. to convert lower-octane gasolines and naphthas into high-test gasoline. The plant comprises a catalytic reactor and a fractionation section to separate the product of the reactor into finished products. Fluor Corp. of Los Angeles will build the platformer.

Construction of both units begins this spring. They will be finished in early 1955. The units are functionally unrelated. Neither will require an increase in the crude charged to the refinery.

After compression and removal of impurities, propane and other refinery gases will be charged to the ethylene unit. The main plant will consist of fractionating towers for separating ethylene, ethane and other hydrocarbons, and cracking furnaces for converting the propane and ethane to ethylene. The Badger Process Division of Stone & Webster Engineering Corp. will erect the ethylene plant.

Gulf Oil decided to build this second ethylene plant at Port Arthur to supply the growing Gulf Coast chemical industry, which uses ethylene to produce ethanol, polyethylene, synthetic rubber, antifreeze and antiknock compounds, emulsifiers, synthetic fibers, acetic acid and chemical intermediates.

Ethylene from the new plant, like that produced in the present unit, will go directly to consumers via pipeline. Contracts have already been signed for much of the ethylene to be produced in the new Port Arthur plant.

How sound is Chemico's cobalt process?

After investigating operations at the new cobalt refinery of Calera Mining Co. at Garfield, Utah, the Battelle Memorial Institute agrees with Chemical Construction Corp., which designed and built the plant, that the new chemical refining process is sound. However, Battelle has recommended changes needed for a commercial operation that may tot up to $1 million.

That's why Howe Sound Co., parent of Calera Mining, has agreed to let Chemico take over the operation of the plant for two years. Ever since the Garfield plant began operating nearly two years ago, production has dragged along at about one-third of capacity, with only intermittent output of cobalt metal by the new chemical refining process.

Now Chemico, a subsidiary of American Cyana-

(Continued on page 112)

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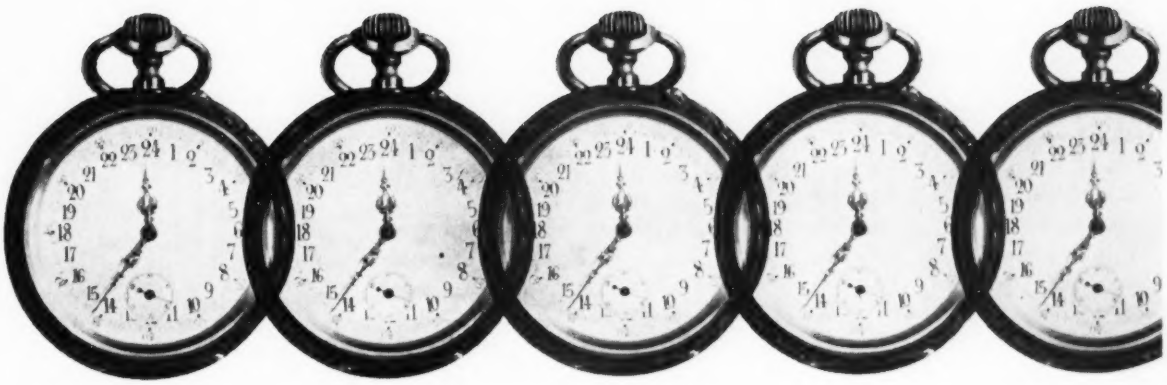

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mid, has stepped in, taking on the task of getting the plant running successfully. Chemico will manage operations at the Garfield plant, which will process concentrate furnished by Calera from its mine at Cobalt, Idaho.

More can now be told about the agreement between Howe Sound and Chemical Construction. Calera will pay Chemico a fixed toll per pound of cobalt alloy and other cobalt products that Calera can market. Chemico will be paid an agreed price per ton for any ammonium sulfate produced.

During the period of Chemico operation, Chemico may purchase and install equipment at an expenditure not exceeding $1 million without prior consent from Calera.

Chemico would then be reimbursed by Calera for such installation expenditures after the two years only if plant tests showed an output capacity of at least 8,000 lb. of metal daily, a minimum recovery of 90 percent of the cobalt content in the concentrate processed, and if costs are kept within a set maximum production cost, according to President H. H. Sharp of Howe Sound. Otherwise, Calera would not be obliged to repay the new capital expenditures made by Chemico.

So look for the ceramic lining

"By 1960 ceramics plants will be coating 97 percent of all exposed steel parts produced in the country to save on the $6 billion annual cost of corrosion." So predicts President Robert A. Weaver, Jr., of the Bettinger Corp. of Waltham, Mass.

Within two years, Weaver estimates 85 percent of commercial aircraft will be using heat-resistant ceramic coatings. Bettinger Corp. at present is successfully turning out high-precision castings for the Air Force. This requires keeping the coatings within a tolerance of 0.001 in. for fitted parts.

"High-temperature ceramic coatings—already used in jet engines," Weaver declares, "will provide a ceramic curtain for our economy in case of war. They will let less critical alloys do the work of rarer ones, thereby saving countless dollars and greatly extending the life of the coated metals."

Reichhold expands basic chemical capacity

To finance its current expansion, Reichhold Chemicals, Inc., has privately sold $1,100,000 of 4½ percent preferred stock. This move boosts the total amount of outstanding preferred stock to $2 million. The new financing, together with retained earnings, brings Reichhold's working capital to a new high.

The new funds will provide for added plant expansion at Reichhold's Tuscaloosa, Ala., and Ballardvale, Mass., plants, and will largely be invested in facilities for the production of formaldehyde and pentaerythritol. The current expansion also involves important changes in phenol operations at Tuscaloosa.

In 1953 Reichhold began an expansion that will enlarge and improve all of its 12 U. S. plants at a cost of $10 million.

A first step will be a $3 million enlargement of the Tuscaloosa plant for the production of 30 million pounds of formaldehyde and 5 million pounds of pentaerythritol, both components of Reichhold's synthetic resins.

Pentaerythritol, used in alkyd resins manufactured by Reichhold, imparts resistance to surface coating materials. It also helps to stabilize the cost of such synthetic plastic vehicles. Increased use of pentaerythritol is expected to minimize price advances forecast by present market trends.

One of the basic aims of the current expansion is enlarged capacity for Reichhold to produce basic chemicals. Such chemicals as phenol, maleic and phthalic anhydride, formaldehyde and pentaerythritol will be manufactured by Reichhold to augment its outside purchases.

Bracing itself for the era of hard selling ahead, Reichhold is counting on its current expansion to give it a competitive edge. It hopes to surpass its current sales volume of about $100 million annually despite increased competition during 1954.

Another producer of para-xylene

Broadening its petrochemical operations, Sinclair Chemicals, Inc., a subsidiary of Sinclair Oil Corp., will become a producer of para-xylene for use as a synthetic fiber raw material.

Para-xylene and other aromatic chemicals will be produced as part of an expansion of petrochemical production at the Marcus Hook, Pa., refinery of Sinclair Refining Co. A special unit will be built to recover para-xylene from a new catalytic reformer already under construction at the refinery.

Capacity of the para-xylene unit, which will start operating in the first quarter of 1955, will be 10 million pounds per year.

Sinclair has contracted to supply para-xylene to Hercules Powder Co. Hercules will convert the para-xylene to dimethyl terephthalate for use by Imperial Chemical Industries of Canada Ltd. in the production of its synthetic fiber Terylene.

In a similar move, Phillips Chemical Co. has begun production of para-xylene by continuous fractional crystallization in a new plant near Big Spring, Tex. Phillips ships its high-purity product to Du Pont at Gibbstown, N. J., where it is oxidized to terephthalic acid, starting material for Dacron synthetic fiber.

As part of its expansion in aromatics, Sinclair will also produce toluene, xylene solvents and heavier aromatics at Marcus Hook.

What's Happening . . . page 114

Why pTBBA *in alkyd formulations?*

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April
1954

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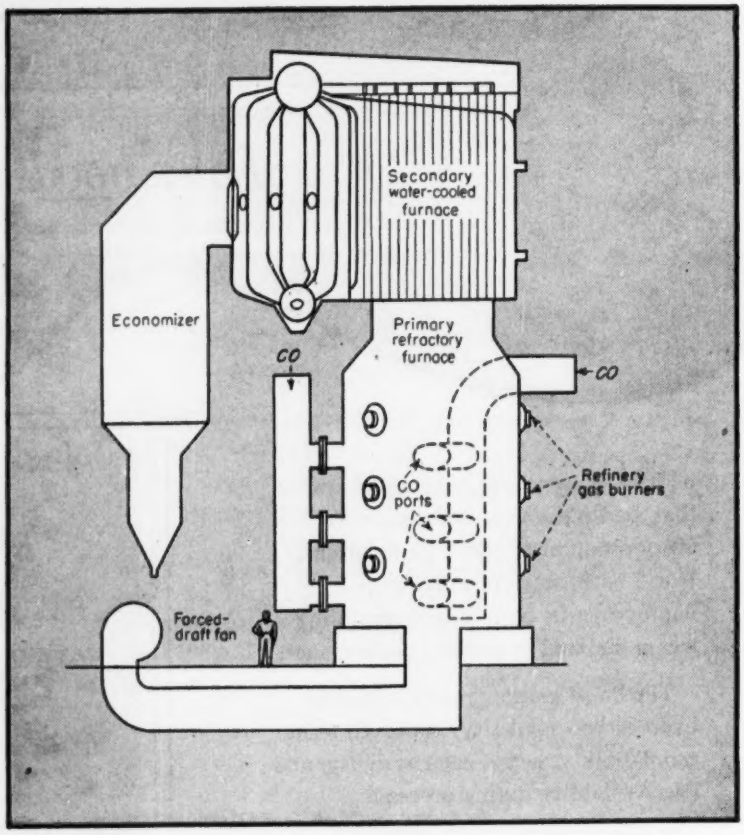
Shell Chemical Brings In New Epoxy Resin Plant

The world's largest epoxy resin plant was brought on stream last month in Houston, Tex., by Shell Chemical Corp. Production from the new plant will triple the company's supply of Epon resins, according to the Shell announcement.

As part of this same expansion Shell built a unit for making bis-phenol-A, one of the two chief ingredients of Epon resins. Shell is now independent of outside suppliers for this material. The other principal ingredient, epichlorhydrin, was pioneered commercially by Shell Chemical.

Epoxy resins were first made available in 1947. Since that time their acceptance has been outstanding, even in the fast-growing resins and plastics field. Epon-based paints are being widely used by washing machine manufacturers, owing primarily to their resistance to alkalis and detergents.

The chemical industry is using such materials in corrosion-resistant container linings and maintenance paints. In the structural field they have had their readiest acceptance in casting and potting electronic components and in manufacture of printed circuits. They have also found wide applications as industrial adhesives.

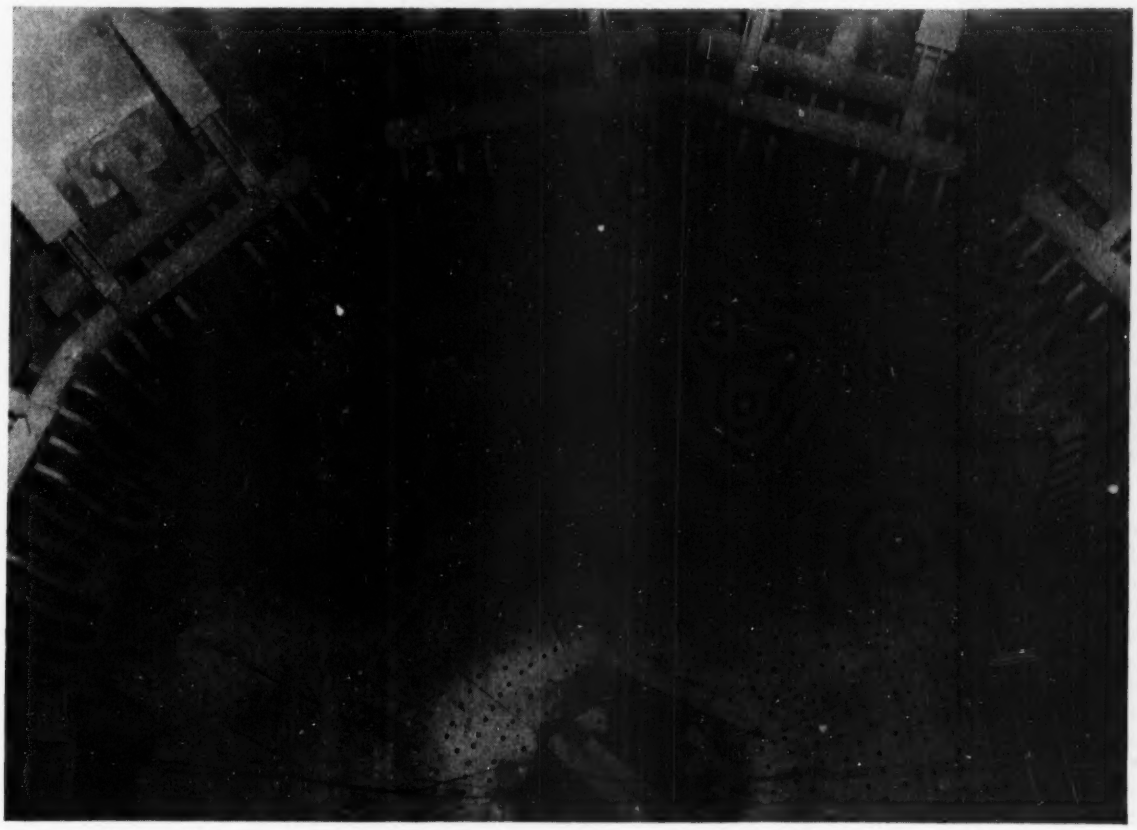


DIRECT-FIRED BOILER burns flue gas CO, makes saturated steam that goes to . . .

Simple New System Turns

Startup of the oil industry's first unit for producing superheated steam from fluid catalyst kiln waste heat marks another high in the Sinclair Refining Co.'s battle to cut costs. In brief, the system is this:

Flue gas from the regenerator is passed into a furnace and directly fired with auxiliary gas to completely combust all carbon monoxide. The sensible heat and heat of combustion recovered is used to produce over



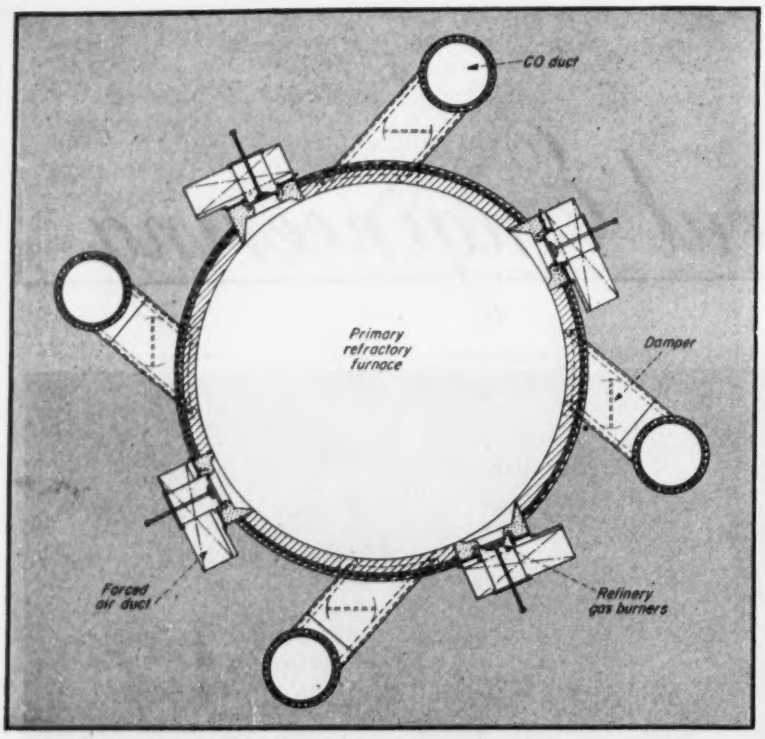
SUPERHEATER COILS immersed in fluidized bed of catalyst regenerator. This recovers excess heat and controls bed temperature.

Cat Cracker Waste Heat to Steam

300,000 lb./hr. of 700 psig. saturated steam with a conventional water tube boiler and economizer.

Even more "waste" heat is recovered by sending the saturated steam, plus some condensate, back through the fluidized bed of the kiln in heat exchanger tubes, where it is superheated. This also serves as an effective way to control bed temperature.

Simple in concept, the operation is currently netting the company's Houston refinery nearly 400,000 lb/hr. of 550 psig., 750 deg. F. steam from just one fluid cat cracking unit. Total auxiliary heat required is only 110 million Btu./hr., less than 20 percent of the total heat needed to make the



TANGENTIAL ENTRY of flue gas, auxiliary fuel and air gives intimate mixing.

same steam in conventional process equipment.

There are other important advantages, too. Maximum flexibility of the fluid cracking unit is obtained with minimum fuel consumption. Escape of carbon monoxide and unburned hydrocarbons—potential air pollution sources—is eliminated. And the capital cost of the CO boiler and its appurtenances is no greater than for a fired boiler of equivalent output.

▶ **Incomplete Combustion** — Fluid catalyst regenerators are normally limited to a bed temperature of about 1,100 deg. F. in order to prevent deactivation of the catalyst by sintering. This, of course, gives incomplete combustion of the coke on the catalyst and leaves about 4.8 percent CO in the flue gas. Most companies allow all the heat value of this gas to go right out the stack.

Sinclair engineers, however, rightly figured that there were probably economical conditions of time, temperature, turbulence and excess oxygen at which about 15 Btu./cu.ft., CO bearing gas would complete combustion, liberating usable heat. To test this theory, they built a pilot plant at Marcus Hook, Pa., in June 1950, and proved that such gases could be completely burned at reasonable operating conditions—10-20 percent excess oxygen in the exit flue gas and thorough mixing at 1,450 deg. F.

▶ **Boiler Design**—The next step was to determine whether or not a commercial unit could be built to burn all the CO in the flue gas at capital and operating costs that could be justified by the fuel savings. There were three major problems: what type of combustion chamber to use; how to insure thorough mixing so as to minimize auxiliary air needs; how high to heat the flue gas with outside fuel.

Furnace choice narrowed down to water-cooled and refractory types. Although the former has a lower first cost, heat absorption from the chamber increases fuel requirements and necessitates a larger boiler. So a refractory was picked as offering minimum fuel consumption with maximum certainty of maintaining combustion temperature at reasonable cost.

Tangential injection of the flue gas, into the primary furnace through several inlet ports at different levels *(above)* seemed to give the best mixing with the simplest equipment. This sets up a swirling action, thoroughly mixing the CO gas with auxiliary fuel and air fired through several burners at different levels.

It was also decided to fire enough auxiliary fuel to raise the flue gas to about 1,450 deg. F., taking no credit for the heat of combustion of the carbon monoxide. This combustion heat would then raise the temperature above 1,450 deg. F. and provide a safe design and operating margin.

▶ **Construction Approved** — On the basis of this preliminary design and pilot plant work, contracts were let in May 1951 for the simultaneous construction of a new fluid catalytic cracker—by C. F. Braun & Co.—and a direct-fired CO boiler—by The Babcock & Wilcox Co. The entire unit went on stream in Oct. 1953.

As built, the boiler consists essentially of a pressurized cylindrical primary refractory furnace—designed for 2,500 deg. F.—and a secondary water-cooled furnace with an economizer. It includes a bypass so that the boiler can be shut down without shutting down the cracking unit.

Twelve tangential flue gas inlet ports are placed at three different levels. Twelve auxiliary fuel burners are also arranged in three symmetrical levels, the highest being above the highest inlet level. This insures that all CO bearing gas must go through at least one level of flame before leaving the primary furnace.

The mixing produced by this system is excellent, as evidenced by the complete combustion of the CO at 1,800 deg. F. with only 2.6 percent oxygen in the boiler flue gas. But the swirling was greater than expected and produced cyclonic action.

Pressure drop from the furnace wall to the center is as much as 8 in. of water; pressure in the center of the primary furnace is 3–4 in. of water greater than in the secondary furnace. Speeding up of the turbine-driven forced draft fan was necessary to provide enough static pressure to force auxiliary air through the cyclonic wall of gases.

Deposition of catalyst fines on the boiler tubes is also a problem. But it has been simply solved by installing 12 Diamond I. K. retractable soot blowers which are used on a once-per-shift cleaning schedule.

▶ **Operation Successful**—Heat balances around the boiler graphically prove the worth of this system. Total heat

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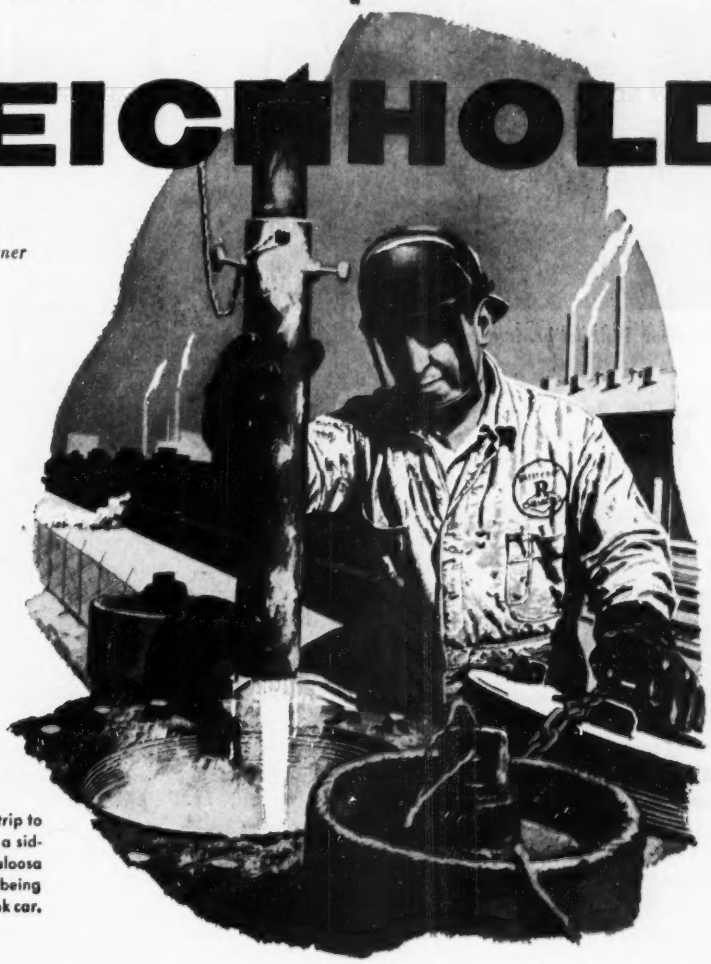
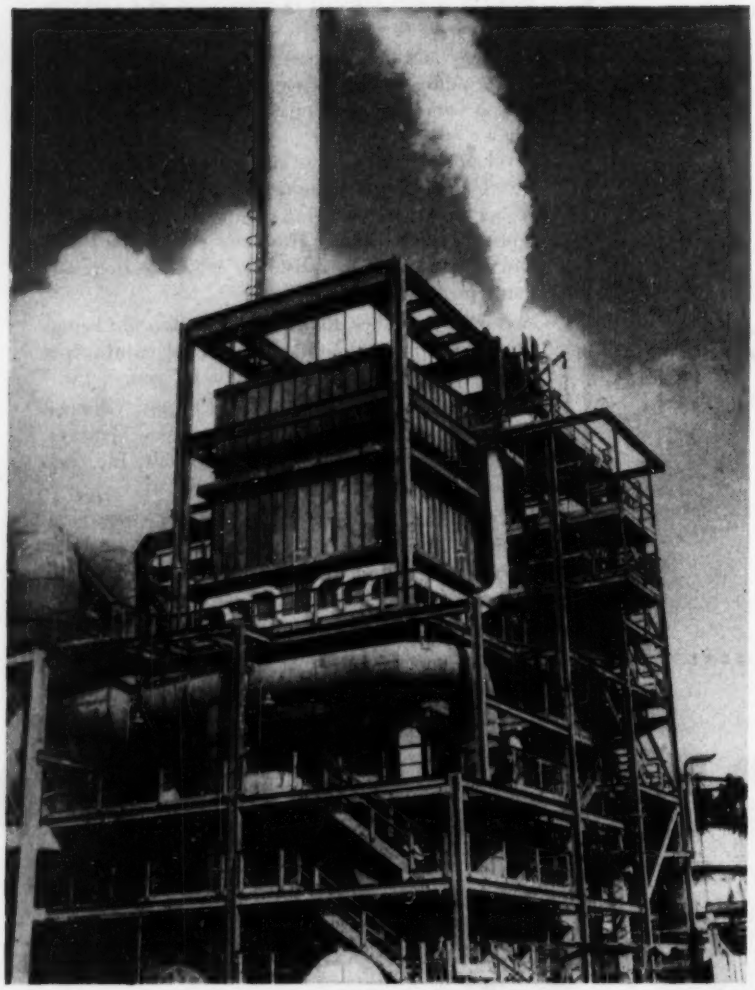


Phenol starts its trip to a customer from a siding at RCI's Tuscaloosa plant where it is being loaded into a tank car.

Formaldehyde
Glycerine
Maleic Anhydride
Phthalic Anhydride
Phenol
Sodium Sulfate
Sodium Sulfite



CO BOILER recovers 310 million Btu. per hr. from new fluid cat cracker regenerator.

input is about 430 million Btu./hr. Of this, approximately 180 million Btu. is sensible heat of the carbon monoxide, 140 million its heat of combustion. Only 110 million comes from auxiliary fuel and air. Thus 320 million Btu./hr., or 74.5 percent of the heat input, was formerly waste heat.

Quantity, temperature and CO content of the flue gas has been so constant that there's not enough variation to permit automatic control. As a result, boiler operation is manually regulated. All other controls are pneumatic to make operation free from power failures.

▶ **Superheat and Save**—The burning of coke from catalyst releases tremendous quantities of heat. Part of this passes out with the flue gas to the CO boiler. Another part is removed by catalyst circulation from the kiln to the reactor. The rest, however, must be taken out by other means in order to keep the bed temperature below 1,100 deg. F.

To accomplish this, the Houston unit has four heat exchanger coils, called respray steam superheaters, immersed in series in the fluidized catalyst bed. Saturated steam from the CO boiler passes through the coils and is superheated by the excess regenerator heat. The superheater material is Croloy 5, a low chromium alloy steel that has indefinite life under conditions inside the kiln with no steam passing through the coils.

The difference between this superheater and one in a boiler is the medium surrounding the coils. In a boiler, hot gases flow past the tubes. But in the Sinclair system the coils are bombarded with very fine, hot catalyst particles. This gives 5–10 times greater heat transfer rates for the same temperature differential.

The ideal design for this system would be to have exact balance between the amount of steam available and the quantity of heat to be removed. In normal operation, however, there's more than enough heat to superheat the steam to the desired level of 750 deg. F. Therefore, a system of desuperheaters had to be installed so that the steam can be alternately superheated and desuperheated —by spraying condensate into it. This allows both bed temperature and steam temperature to be controlled over a wide range of steam flows and heat removal requirements.

Should there ever be too much steam for the amount of excess heat, the regenerator bed temperature controller will act to pass some of it through a bypass steam line around the coils. The final steam blend—from the coils and the bypass—must be 750 deg. F., however. This is accomplished by automatically regulating the temperature of the superheated steam so that it will blend with the bypass steam to the correct temperature.

All controls for both the CO boiler and the superheater system are located at the fluid unit. This minimizes the operating personnel required.

▶ **Heat Removal Varies**—Actual field tests of the respray superheater show a maximum heat removal of 169 million Btu./hr. The amount of heat needed to superheat the steam from the CO boiler to 750 deg. F. is 80 million Btu./hr. Thus the heat absorbed by the superheater system will vary from 80 to 170 million Btu./hr., depending on the amount of heat that must be removed from the regenerator.

Over-all operations of this unusual heat recovery combination have been better than expected. Both units produce steam at substantially constant pressure and rate. Under these conditions, even manual control of the primary furnace is satisfactory.

As Sinclair officials put it, competition dictates constant emphasis on cutting operational costs. The CO boiler to minimize fuel consumption by utilizing waste heat and the respray system to provide optimum catalytic cracking are important new tools to meet this challenge.

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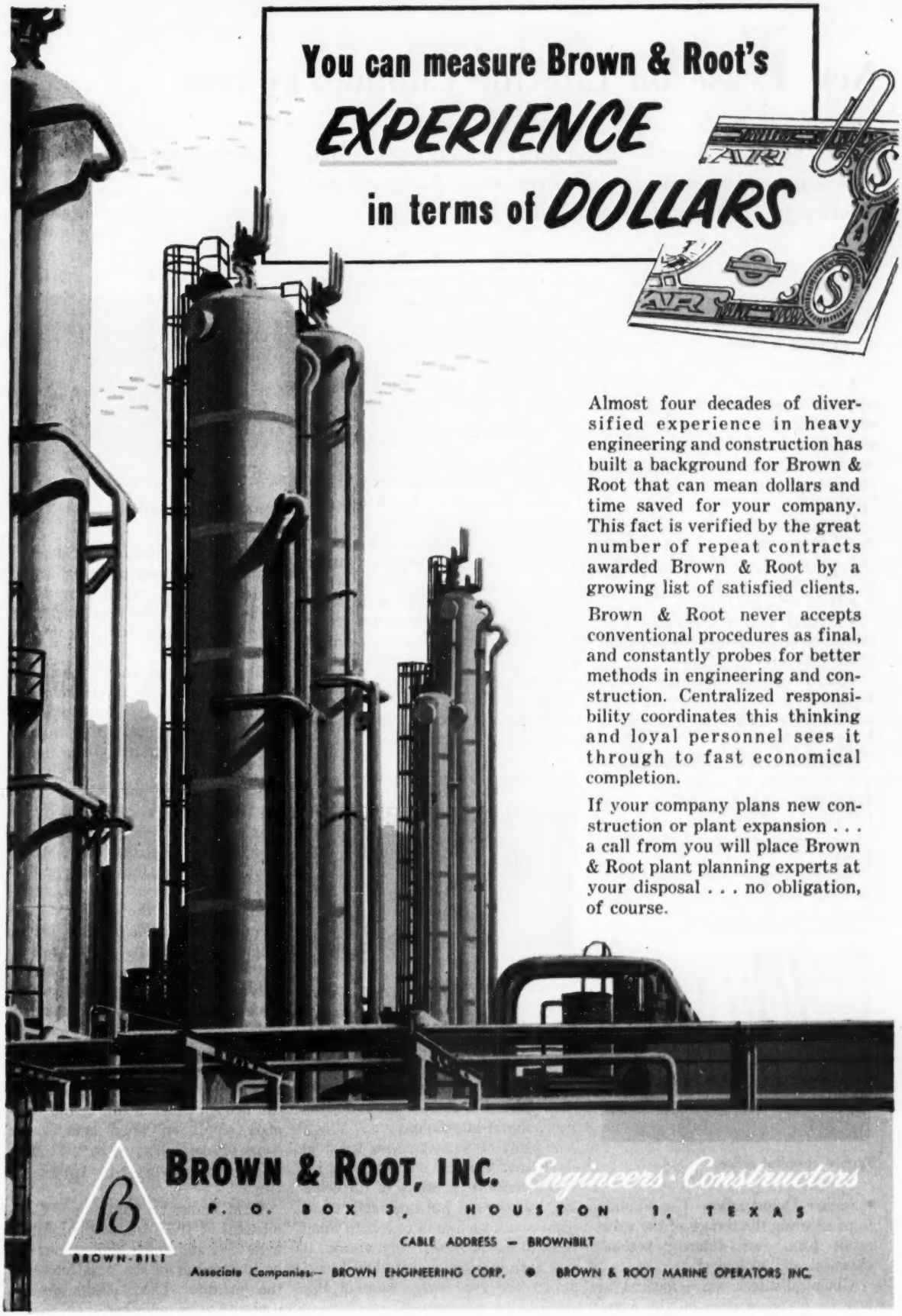

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New Lease on Life for Cooling Towers

Study of abnormal wood decay in Gulf Coast installations pins down causes, suggests remedies. Water pH and chlorine residuals must be watched.

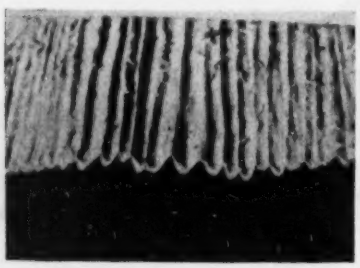
Extremely rapid deterioration of redwood in cooling towers in the Gulf Coast area has come to the attention of engineers in this region during the last five years.

A general remedy for relieving this situation comes from the combined efforts of the Cooling Tower Institute and California Redwood Association –a field survey to diagnose and, if possible, prescribe treatment for the "patients."

Here's what the "doctors" recommend to prevent excess chemical attack and minimize biological infection of cooling-tower wood:

- Hold water pH between 7 and 7.5.
- Control sodium carbonate concentration by converting to sodium sulphate with sulfuric acid.
- Keep chlorine residuals below 1 ppm.
- Maintain inlet water temperature below 120 deg. F.
- Provide adequate sanitation measures–inspection of wood, removal of algae, mud, and other deposits, general cleaning of the tower system as a whole, immediate removal of infected wood.

The survey studied two major kinds of wood failure–surface deterioration and internal deterioration.



Surface chemical action.

▶ **Surface Deterioration**–Those conditions affecting the surface of the wood result from two different actions, chemical and biological.

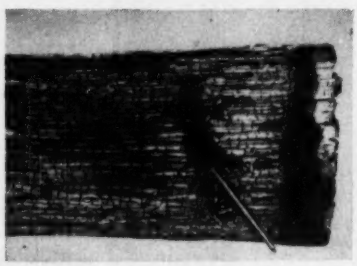
Chemical attack was evidenced by a white fibrous surface on the wood. Chemical analysis of the wood showed selective lignin removal, attributable to the action of alkaline solutions and oxidizing agents (such as chlorine).

The pH of the circulating water is usually too low to qualify as a highly alkaline solution. However, long-term tower operation showed that pH values above 7.5 lead to high surface concentrations of alkaline materials.

Tower operators reported that rapid chemical deterioration is also produced by increasing chlorine residuals.

These facts substantiate the theory that chemical agents were responsible for this type of surface attack.

Degradation was found to be severest in parts of the towers subject to flowing water and in those air inlet areas where drops of water splashing on louvers evaporated completely, mechanically disintegrating the wood as crystalline solids formed beneath the surface.

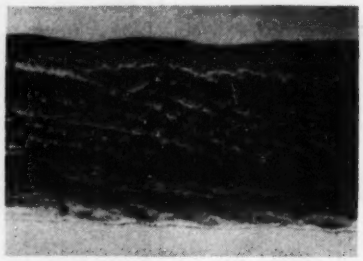


Surface biological action.

▶ **Fungi Are Blamed**–Biological attack of the surface, which is probably preceded by chemical degradation, results in a brittle, crumbly surface condition. Chemical analysis showed selective removal of cellulose.

A study of water analyses failed to show any chemical conditions which would account for attack of the cellulose. However, isolation and transplantation to redwood of certain fungi resulted in continued wood attack. It was therefore concluded that fungal action was the prime cause of this degradation.

Although several characteristics may be used to differentiate between chemical and biological attack in flooded portions of a tower mycological study is necessary to make a positive identification.



Internal biological action.

▶ **Internal Deterioration** – Chemical degradation followed by fungal action results in a brash, crumbly condition in the interior of the wood. Selective removal of cellulose was indicated by chemical analysis.

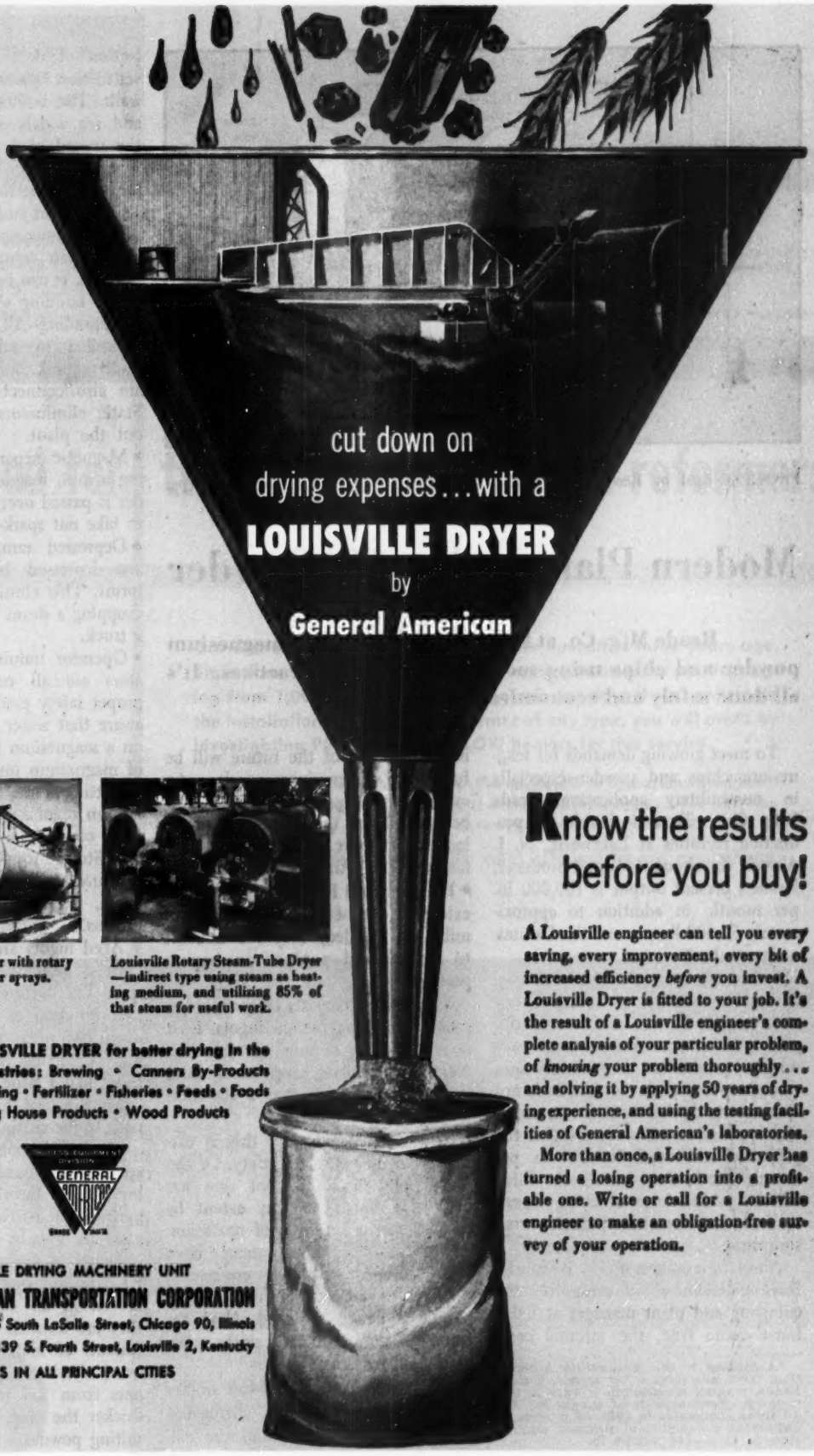
Here again, no known chemicals causing this condition were found to be present, but fungi were. Hence, the investigators concluded that interior degradation was primarily of a fungal nature.

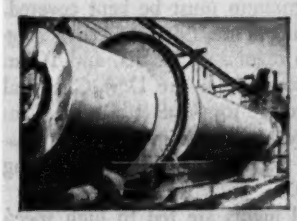
Again, high pH and chlorine residuals may explain this action. It occurs –in greatest intensity–in the non-flooded portions of the tower on the leaving-air side of the water distribution system.

▶ **CTI**–Realizing the need for basic technical information in the field of cooling tower design and operation, nine companies engaged in the manufacture and sale of industrial water-cooling equipment have joined together to form the Cooling Tower Institute, with headquarters in Palo Alto, Calif.

The first technical report issued by the new institute is this iterim summary report on wood maintenance based on data obtained in 1951 from 103 redwood towers in the Gulf Coast area.

Field studies are continuing. Compilations of 1953 data and correlation with 1952 and earlier observations will be undertaken in the near future by the institute. These results are also expected to be published.





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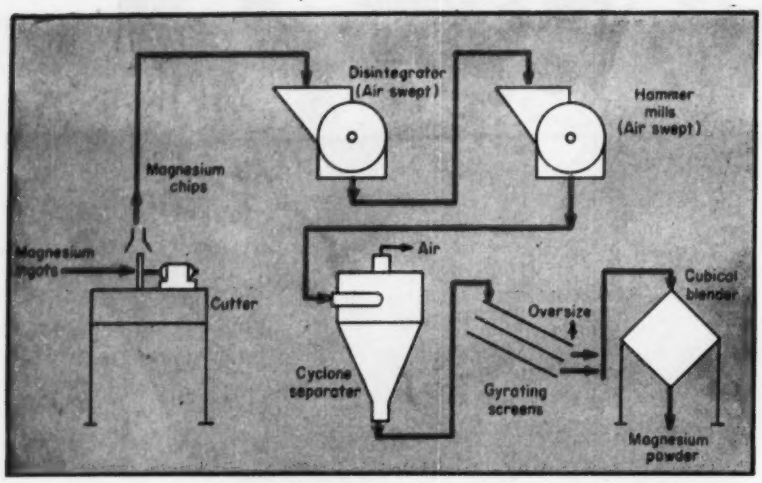

PROCESS used by Reade Mfg. involves machining, grinding and screening steps.

Modern Plant Makes Mg Powder

Reade Mfg. Co. at Lakehurst, N. J., makes magnesium powder and chips using modern engineering practices. It's all done safely and economically.

To meet growing demands for magnesium chips and powder–especially in non-military applications–Reade Mfg. Co. will soon double its production facilities at Lakehurst, N. J. Already the country's largest producer, Reade's present output is 100,000 lb. per month, in addition to approximately 50,000 lb. per month of aluminum powder.*

Increasing use of disintegrated magnesium in chemical synthesis, electroplating, powder metallurgy and display pyrotechnics before long may relegate production for military uses to a secondary position. Although not at liberty to disclose specific customers and applications, Reade says that the projected additional 100,000 lb. per month production, most of which will be in the form of chips, is earmarked for chemical industry consumption.

And if the dreams of Dr. Joseph H. Scharen–technical director of the company and plant manager at Lakehurst–come true, the internal combustion engine of the future will be fueled by magnesium powder. An experimental Mg-fueled engine is now being built at the Lakehurst plant, located a short distance from the famous Naval Air Station.

▶ **Hammer Mill Process**–Reade makes extensive use of hammer mills. Ball mills are avoided; they are difficult to control and produce an impure product.

The process consists of three steps, starting with magnesium ingots. First is a machining or cutting operation. Next, the resulting chips are ground in hammer mills. Last is a classification or screening step.

▶ **Paragon of Safety**–All this is carried out with complete safety. Of the 45 people employed, not one has ever been burned to any extent by magnesium in six years of operation. Behind this accomplishment is a highly modern, carefully engineered plant–a model example of how to handle a dangerous solid. Here are some of the up-to-date safety practices used by Reade:

• Open-air construction–Most of the 35 buildings, made of corrugated sheet, are designed to minimize collection of dust pockets. There are ventilation spaces between roof and walls. The buildings are wind swept, and are widely separated to prevent the spread of fire.

• Housekeeping–The plant is spotlessly clean. At the end of every shift, all equipment and buildings are blown off with compressed air. There is a portable air compressor for this very purpose. It can be hauled from building to building when needed.

• Grounding–All equipment is grounded to cables buried 30 ft. underground. Building lightning rods are also connected to these cables. Static eliminators are used throughout the plant.

• Magnetic separators–Before entering a mill, magnesium chips or powder is passed over magnetic separators to take out spark-producing iron.

• Depressed ramps–Concrete ramps are depressed below loading platforms. This eliminates the danger of dropping a drum while lifting it onto a truck.

• Operator training–The plant operators are all carefully trained on proper safety practices. They are well aware that water is never to be used on a magnesium fire, and that drums of magnesium must be kept covered.

▶ **Cutting**–Pure (99.8 percent) magnesium ingots, 4½ in. dia. and 16 in. long, come from the Dow Chemical Co. Storage for 90 days at room temperature makes them easier to machine, the result of a sort of aging process.

Aged ingots are fed to high speed cutters, turning at 3,000 to 5,000 rpm. The cutters perform the important function of breaking the ingots down to a manageable form for grinding. A cutting machine looks something like a lathe. However, unlike a lathe, the feed-stock moves on a carriage to the cutting blades.

No liquid coolants, cutting oils or cutting compounds are used. This is because the burning characteristics of magnesium, particularly for pyrotechnics, are greatly influenced by small amounts of impurities.

▶ **Chips and Buds**–The chips are removed in an air stream as fast as they are formed. They are fine, light ribbons of metal, closely resembling wood shavings. They range in thickness from 1.5 mils to ☆ in. The thicker the chip, the coarser the resulting powder.

*According to the Magnesium Association, there are three other plants, besides Reade, making magnesium powder in this country. Estimated total production for all three companies in 1953—3 million lb. Estimated production of primary magnesium in 1953—150 million lb.

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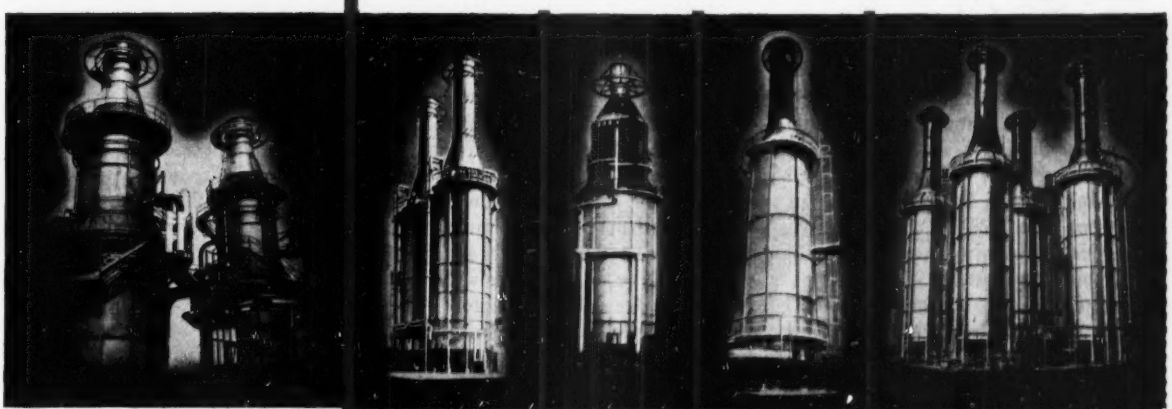

PETROCHEM-ISOFLOW FURNACES

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WIDELY SEPARATED buildings are a feature of the Mg powder plant.

Cutting is a critical operation from this standpoint. An error in thickness will increase costs all the way down the line. Chips that are too thick will mean more work for the mills. Chips that are too thin will mean an extra blending operation and a large percentage of unusable fines.

The air stream carries the chips through 6-in.-dia. copper or galvanized ducts to a disintegrator. Chips are broken up here into ¼-in. sections called "buds." The disintegrator—actually a 20-in.-dia. hammer mill with the hammers removed—has an attached fan supplying the air pressure for the ducts. Air sweeps the buds into a hopper. From there they go to metal drums.

Buds are used principally as feed material for the hammer mills. But they are also sold for direct use in chemical applications, such as in Grignard reactions.

▶**Grinding**—This operation, outwardly, looks surprisingly simple. But a lot of careful engineering design has gone into it.

Grinding is all under automatic control. First, feed is manually charged to a hopper. The operator then leaves the building and goes to another where the controls are located. He sets the timing mechanism and starts the mill. Feed rate is controlled with a vibrating feeder. Grinding is stopped automatically by the timing mechanism. The operator then enters the building to prepare for the next charge.

These mills, running at 4,000 to 5,000 rpm., produce 50 to 100 lb. per hr. of powder. No inert atmosphere is used. No cooling, besides the flow of air through the mill, is used. Shortly after the grind is started, magnesium coats the steel hammers, eliminating the danger of sparks from contact of steel against steel. Motors are sealed to prevent metal powder from entering.

From the mills, the powder is picked up in an air stream, conveyed through 6-in. ducts to a cyclone separator, and collected in metal drums.

The plant is capable of turning out a wide range of powder granulations by simply changing the hammers or the screen in a mill. Usually the first grind, after the disintegrator, will produce a powder of approximately 100 mesh. A second grind will bring this down to about 200 mesh.

For many uses, the 200-mesh powder is entirely adequate. But if a still finer product is required, additional grinding is carried out in a Pulver-Sizer. Reade has a battery of three of these pulverizers, set off from each other with 12-in.-thick brick walls.

▶**Screening**—The hammer mills produce a powder having a wide size distribution. To get a more closely sized material, the powder is screened on gyrating screens. The screens are 40 by 120 in., made of silk, stainless steel or bronze.

Granulation requirements are so strict for some applications that a slight leakage from one screen to another causes material to be rejected. This problem was solved by modifying the screens so that they seat very accurately on the screen frame. The screens are also stored on individual racks in an enclosed building to prevent warpage.

High-humidity days were a big problem at one time in the screening operation. Screens would blind with moist powder, considerably reducing capacity. Now, on humid days, a battery of infrared lamps are swung over the screens—and screening continues without any difficulty. No one has come up with a way of handling thunder and lightning storms. The plant shuts down under such conditions.

Various meshes collected from the screening step are blended in a cubical, copper blender of 1,000 lb. capacity. Frequent samples are taken as a check on the operation.

From the blender, the powder is packed out in metal drums. These drums are used for both intraplant handling and outside shipments. They are always kept covered to prevent water from getting at the powder.

▶**Powder-Puff**—For unusual jobs, where an extremely fine powder is required, magnesium is screened on a specially designed octagonal silk screen 6 ft. across.

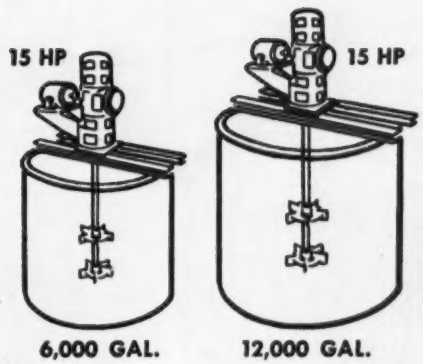
The screen rotates at 20 rpm., throwing the coarser particles to the outer rim. The fine powder collects in the center of the screen. The machine is aptly called a "powder-puff" screener. Fine product made here resembles a good grade of face powder.

▶**Orderly Progression**—There is an underlying philosophy at Reade, upon which the process is based. In Dr. Scharen's words:

"Our operation is a gradual one. We do no severe grinding here. The ingot is gradually worked down—first the cutters, then the disintegrators, then the hammer mills and finally the pulverizers. Eliminate any of these steps and you run into trouble."

The result is one of the most modern plants in the country for making magnesium powder.

Are you buying more mixer horsepower than you need?



YOU may be in the same boat with the chemical company that saved itself an unexpected 50% on first cost of some fluid mixing equipment.

This company wanted to make up a uniform slurry of resin particles in water, in three tanks each holding 12,000 gallons.

After studying the requirements, one of our engineers recommended a 15-horsepower LIGHTNIN Mixer for each of the three 12,000-gallon tanks.

"Not enough power," said the customer.

He told us he was already mixing the same materials in smaller batches of 6,000 gallons. And he was already using 15 horsepower to do it. Did we think we could mix a batch 100% bigger, with no increase in power?

Where had we missed the boat?

The engineer rechecked. His figures were based on hundreds of similar jobs, plus literally thousands of pilot plant runs with calibrated impellers. On paper, he was still dead right. Only 15 horsepower would be needed.

This was good news for the customer—if the engineer could get the customer to believe it.

The engineer knew what kind of impellers the customer was using in the 6,000-gallon tanks. He decided to find out, on paper, how much power these impellers were drawing.

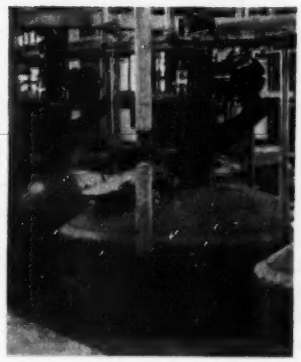
He came up with a figure of less than 7½ horsepower! Was the customer using 15-horsepower mixers to do a 7½ horsepower mixing job?

To check it, the customer himself took power readings on his installed mixers.

"Oh-oh," he said. Sure enough, the 15-horsepower mixers were putting less than 7½ horsepower into each batch. The mixers were a good 100% oversized.

"I'm sold," said the customer. And his new mixers cost him far less than he had expected.

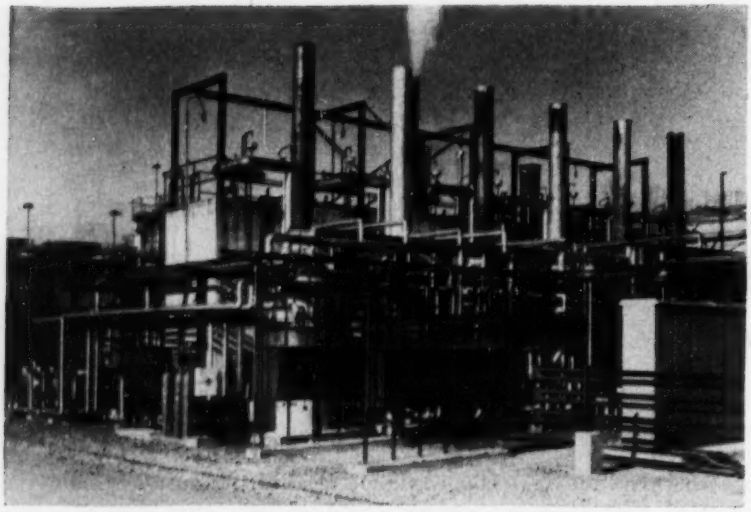
Installed two years ago, the three LIGHTNIN Mixers are performing their job satisfactorily.



Many companies (yours, perhaps?) are spending too much money to mix fluids. There's a quick, easy way that cuts your research cost, engineering cost, installation cost, maintenance cost. It's all described in a new 30-minute color film, "Fluid Mixing." For a free showing at your company—without obligation—write to MIXING EQUIPMENT Co., Inc., 128-d Mt. Read Blvd., Rochester 11, N.Y.

You can cut cost . . . eliminate risk . . .

get going faster . . . with "Lightnin' Mixers"



New Ammonia Process Starts Up

Partial oxidation of methane, liquid nitrogen scrubbing of hydrogen, novel German booster-compressor feature Spencer's new ammonia plant.

First commercial plant to make ammonia via partial oxidation of methane started up late in January at Vicksburg, Miss. Operated by Spencer Chemical Co., the new plant has a design capacity of 210 tons per day of anhydrous ammonia, plus 110 tons of nitric acid, 140 tons of ammonium nitrate solution and 350 tons of ammoniating solutions per day. Cost of the plant was about $14 million.

The partial oxidation process is the result of extensive research and development by Texaco Development Corp. and Hydrocarbon Research Corp., each of which owns basic patents. Although Spencer uses natural gas, the process can also employ liquid hydrocarbons or coal.

▶**Air Separation**—Hydrogen for ammonia synthesis is produced by controlled burning of methane in oxygen. Oxygen comes from an air separation unit that liquefies 1,000 tons of air per day. Novel feature of this unit is that oxygen, after separation from other components of air, is pumped from the distillation column as a liquid and is gasified on its way to the hydrogen generators by heat exchange with the incoming air.

Air for the separation plant is first filtered, compressed to 125 psig. with two centrifugal compressors (mounted on a single shaft) with intercooler, then raised in pressure to 600 psig. by gas engine-driven reciprocating compressors. The air is then chilled with ammonia and dried with activated alumina before entering the exchangers, where it is cooled by the products leaving the separation unit. Further cooling and subsequent liquefaction is attained via a turbo-expander and expansion valves.

In addition to making 95 percent oxygen (higher purity is obtainable) this unit supplies 99.99 percent nitrogen, which is added to the hydrogen to make up the ammonia synthesis gas. A portion of the nitrogen is liquefied and used for scrubbing the hydrogen stream to purify it.

▶**Making Hydrogen**—Natural gas is compressed to about 400 psi. and preheated, then mixed with oxygen and burned by a specially designed burner inserted in a refractory-lined vessel. Product gas is high in hydrogen and carbon monoxide content.

After cooling by direct scrubbing with water, the gas goes to a shift converter, where CO is catalytically converted to CO_2 and more hydrogen.

There are three purification steps. First, direct scrubbing with monoethanolamine gets out most of the carbon dioxide. Washing with caustic solution gets out most of the remaining CO_2. Finally, washing with liquid nitrogen at temperatures below −300 deg. F. removes final traces of CO, CO_2 and methane (see *Chem. Eng.*, July 1953, p. 133).

During the nitrogen washing step, pure nitrogen evaporates into the hydrogen to the extent of about 10 percent by volume. More pure nitrogen is added to the gas stream leaving the purification system to give a composition of 75 percent hydrogen, 25 percent nitrogen.

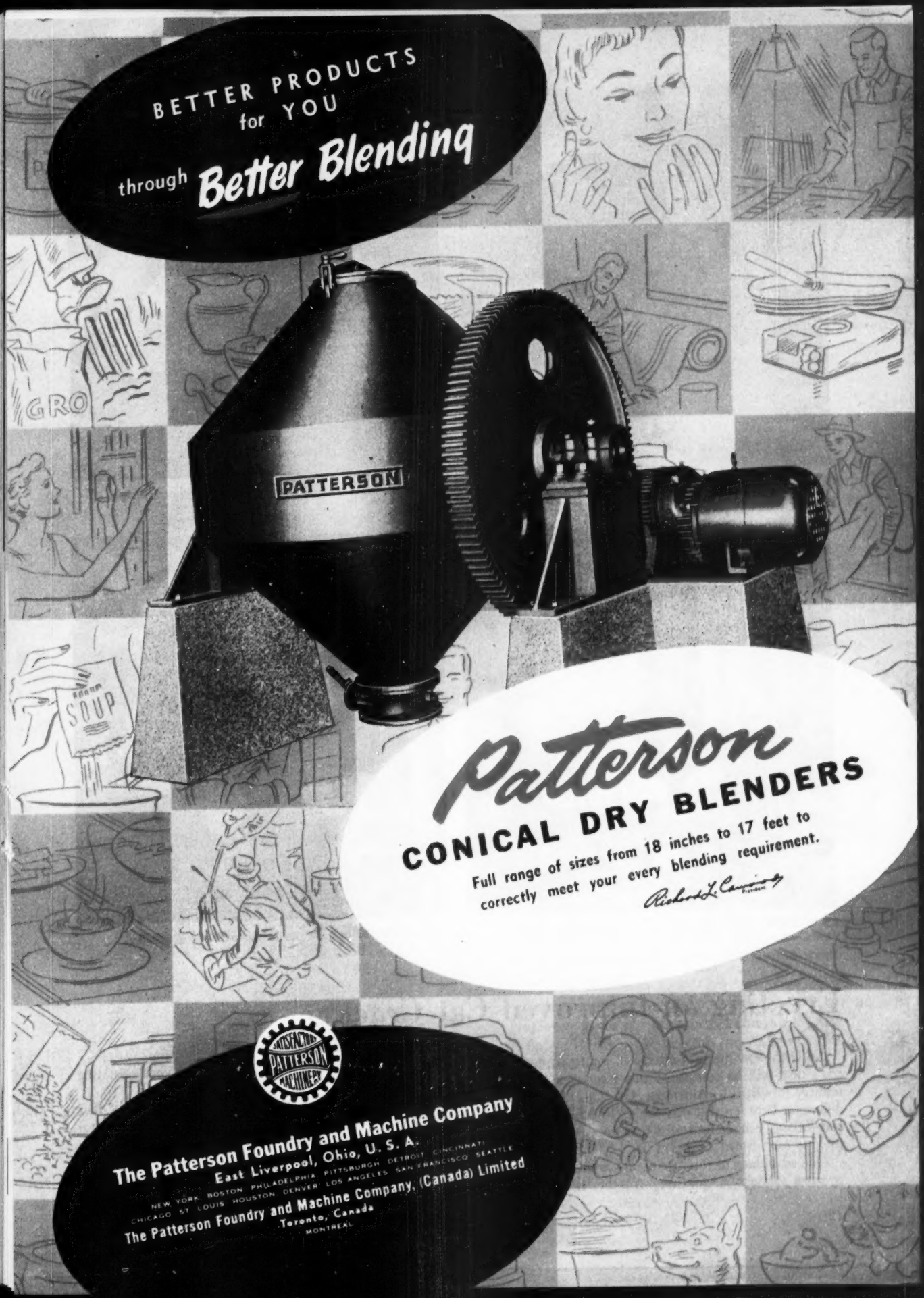
▶**Ammonia Synthesis**—Hydrogen-nitrogen mixture is converted to ammonia by compressing it to 3,600 psig. and passing it through a catalytic converter. Although conventional conversion pressure is 4,500 psig., higher purity of the synthesis gas permits operation at the lower pressure.

The ammonia produced has a purity of 99.99 percent without the use of distillation. Another advantage of higher-purity gas is said to be a 15 percent reduction in consumption of natural gas for both synthesis and fuel.

Unreacted gases from the converter are separated from the ammonia produced by two-step cooling and recirculated to the converter with a novel German-made centrifugal booster compressor or circulator. The electric motor driving the compressor is built into the machine. This compressor requires very little lubrication, making it possible to produce ammonia with essentially no oil contamination.

▶**Plant Layout**—Principal operating building houses the compressors and control instruments. The compressors occupy the central area, with instrument panels located around the four walls. Almost all the other equipment is outdoors.

Much more automatic control equipment has been provided than normal for an ammonia plant. Instead of multiple hand control valves Spencer depends on automatic control valves, differential control valves, temperature cut-offs and back-pressure reliefs. Automatic control and compactness of the plant makes possible operation with eight operators per shift.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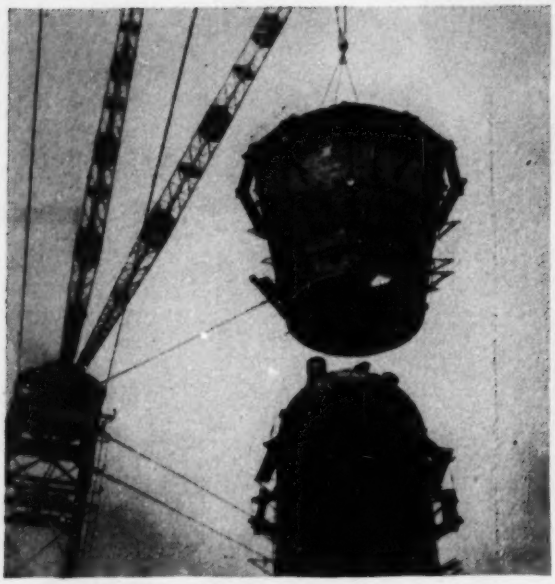
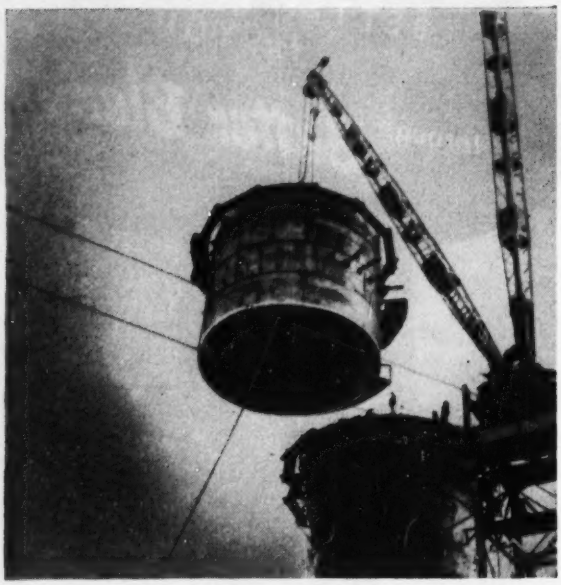
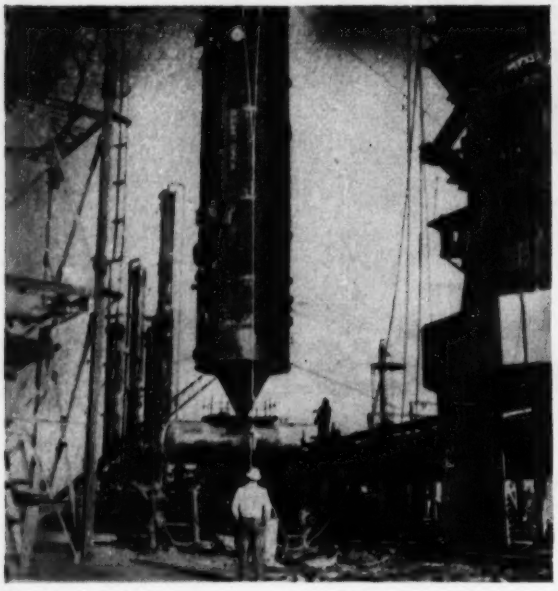


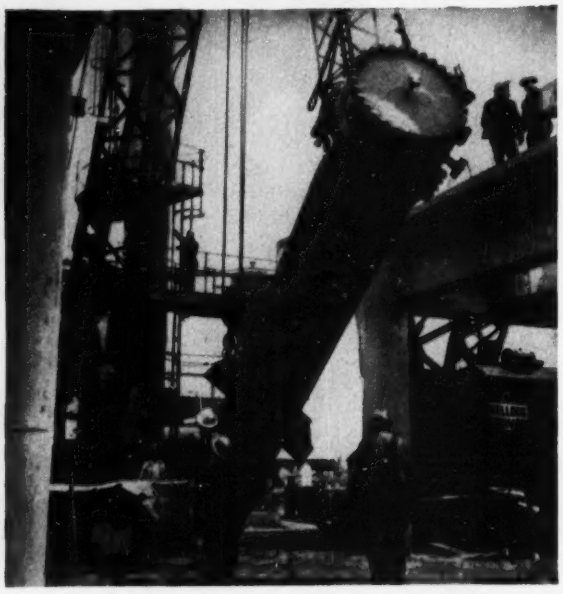
CAT CRACKER as transition skirt goes atop reactor.



REGENERATOR is placed above reactor in new design.



FRACTIONATOR goes up next to Orthoflow cracker.



REACTOR for new cat polymerization unit is installed.

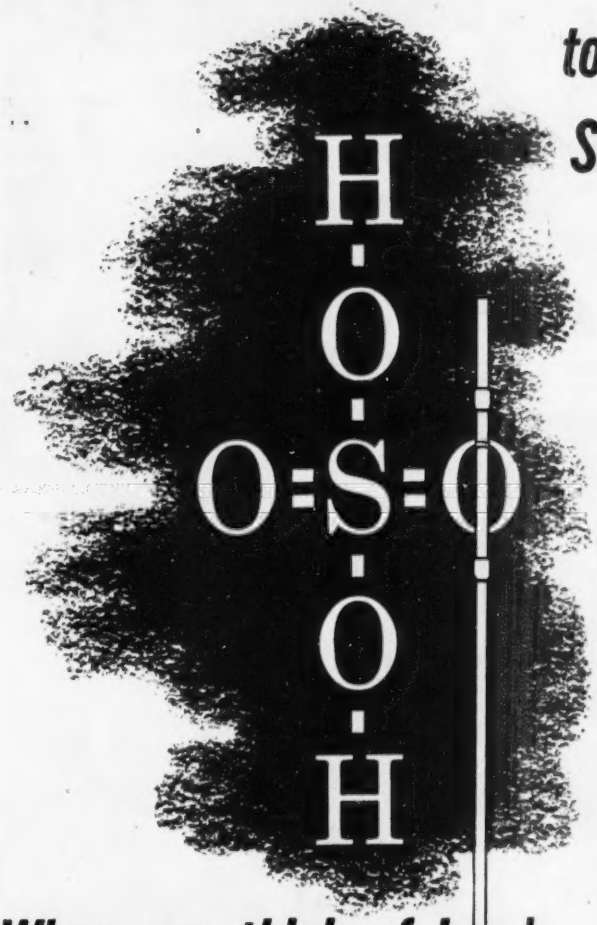
Erecting an Improved Cat Cracker

An Orthoflow fluid cat cracker of improved design, Canada's first, will be completed this summer at the Ontario refinery of British American Oil Co., Ltd. Principal difference between this new design by M. W. Kellogg Co. and Kellogg's other version is that the regenerator is above the reactor instead of below it.

One advantage of the new design is that the regenerator operates at lower air pressure. Another is the smaller size of reactor and fractionator—a result of higher operating pressure in the reactor.

The cat cracker will process 8,000 bbl. daily. Other new units include a vapor recovery system, sulfur removal equipment and a catalytic polymerization plant. This is the second Orthoflow unit that Kellogg has built for British American; an earlier version has operated for over two years. Canadian Kellogg is handling the current job.

When *is Lead used to control Sulphuric Acid Corrosion?*



Sulphuric acid is like "Peck's Bad Boy."

It has plenty of outstanding qualities, but it's hard to control.

Ordinarily, lead is the metal used by industry to keep sulphuric acid corrosion within limits. Lead is often used when H_2SO_4 concentrations go as high as 96% at room temperature or as high as 85% at 220 degrees Centigrade.

When making equipment to handle H_2SO_4 within such ranges, lead will usually give you the most practical combination of corrosion resistance, simple fabrication, and reasonable cost. No common metal is easier to work than lead and it is economical, both in first cost and in maintenance.

With other corrosives the detail differs but the story is much the same. So when you think of corrosion resistance, think of lead and . . .

When you think of Lead . . . think of National Lead

WHAT GOES FOR LEAD AND H_2SO_4 GOES FOR LEAD AND HUNDREDS OF OTHER CORROSIVES

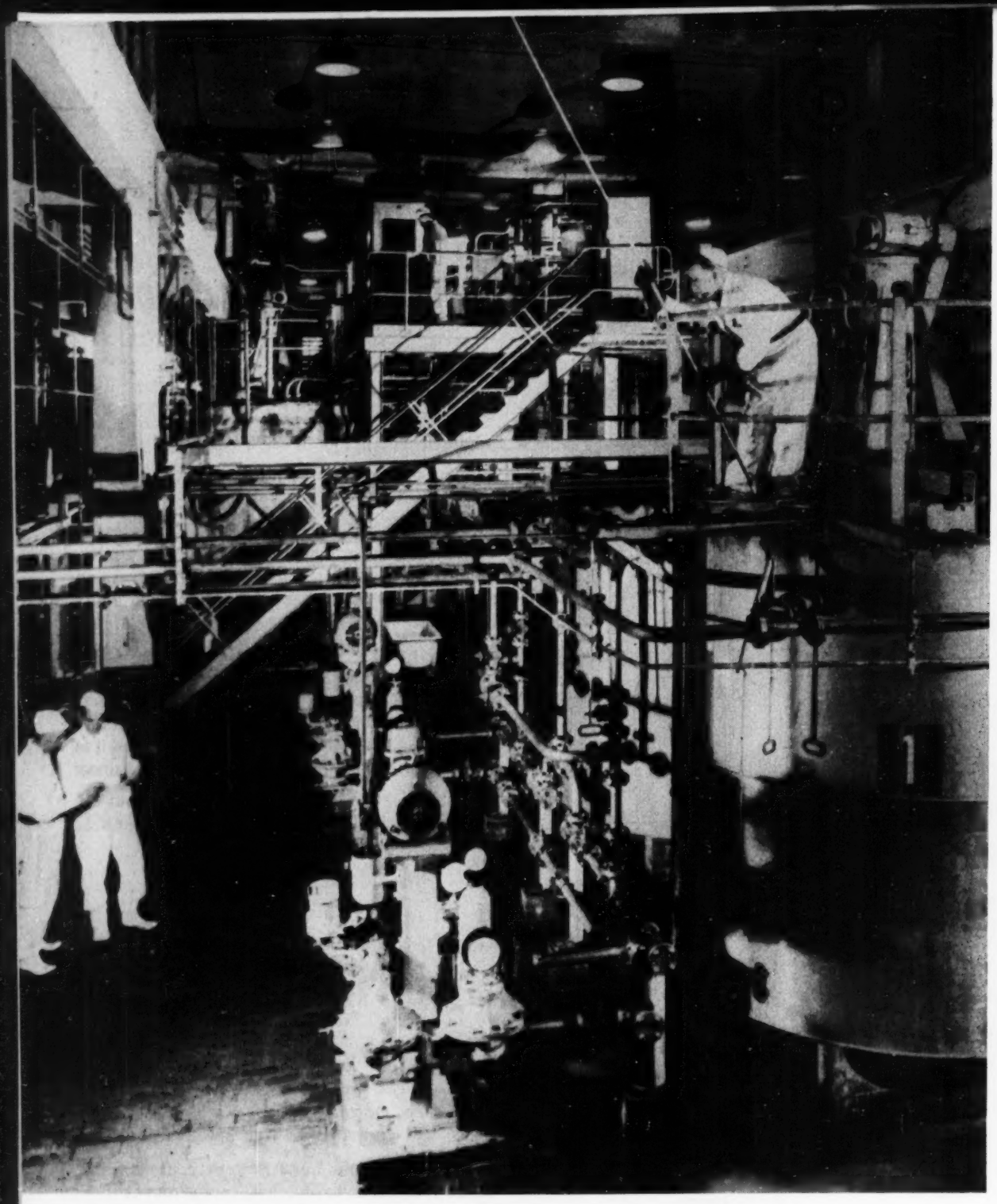
National Lead puts lead in your hands in any grade you may require and in every conceivable form — sheet, pipe, coils, fittings, valves, pumps and vessels. Or you can have National Lead fabricate lead equipment to your specifications.

So put National Lead first in your thinking when you want to combat corrosion. Call on National Lead for technical assistance. Ask for a copy of the new booklet on "Chemical Lead Products."

National Lead Company

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited).

*Reg. U. S. Pat. Off.



Inside Three Atomic Factories

SECURITY blackout has been lifted—just a little—to give us a peek at the engineering behind Britain's atomic energy program. They have now progressed from the research stage into that of regular manufacture.

There are three large plants in the British North West. The first, at Springfields, is where the African ore is crushed, ground, dissolved (*above*) and converted to uranium. Springfields supplies metal for the plutonium piles at Windscale, and hexafluoride for the U-235 gaseous diffusion plant at Capenhurst. **Continued on page 132▶**

Controlled concentration of solids from slurries is a function which the Sharples DH-2SG Nozljector performs with high efficiency.

The re-cycle feature of this continuous centrifuge permits close control of heavy solids concentration without sacrifice of clarity, or throughput capacity. Re-cycling also provides an easy means of compensating for variation in feed concentration.

Sharples has engineered the DH-2SG with 40% greater capacity, without increasing the machine size, and without increasing power consumption per unit of throughput. It is being extensively used in the concentration of mill starch, gluten and other vegetable proteins, citrus products and similar applications where its completely sanitary construction is required.

The Sharples line of nozzle type centrifuges, both standard and re-cycling, are giving the right results in plants with a variety of concentrating problems. Call your nearest Sharples office or write for Bulletin 1253.

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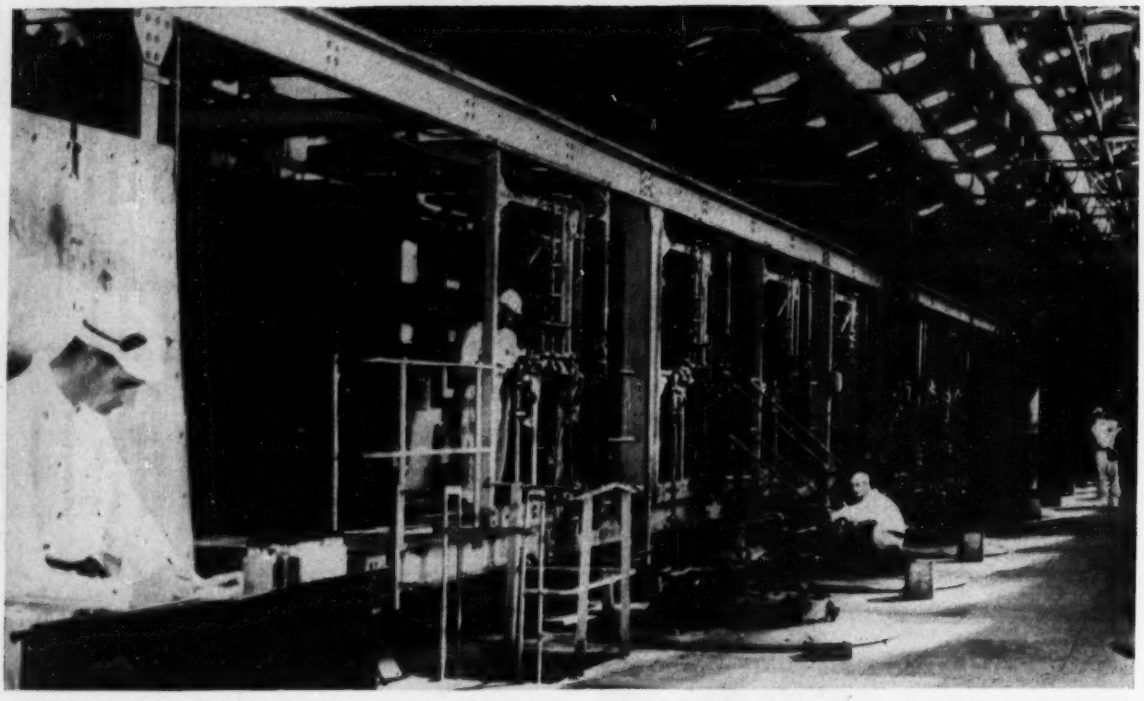
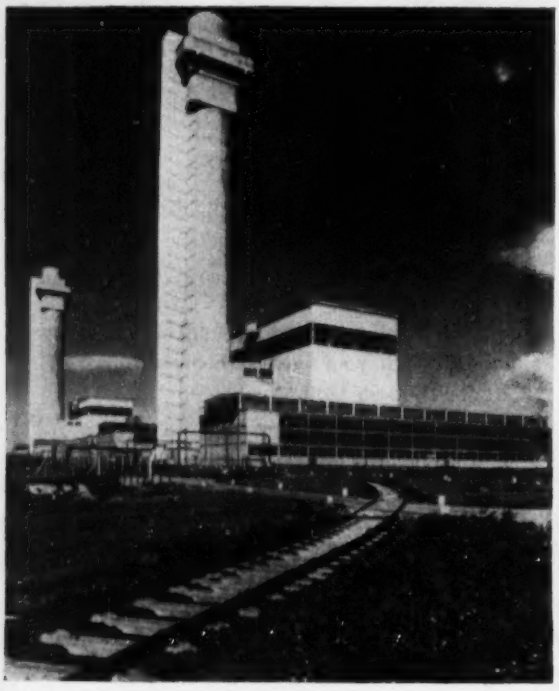
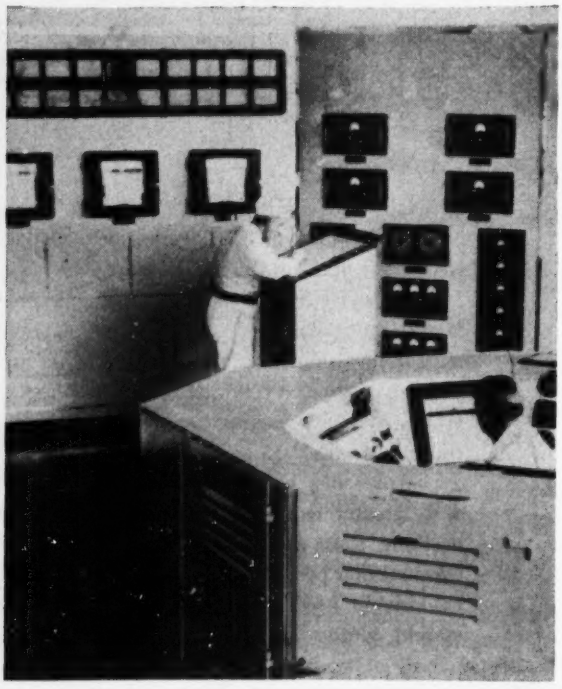


ELECTRIC FURNACES at Springfields where ammonium diuranate is converted to pure uranium tetrafluoride by heat, reduction and hydrogen fluoride. Solid uranium tetrafluoride is mixed with calcium chips and fired resulting in reduction to metallic uranium. After testing, uranium is remelted, cast into rods and canned. Thousands of such rods have been made.

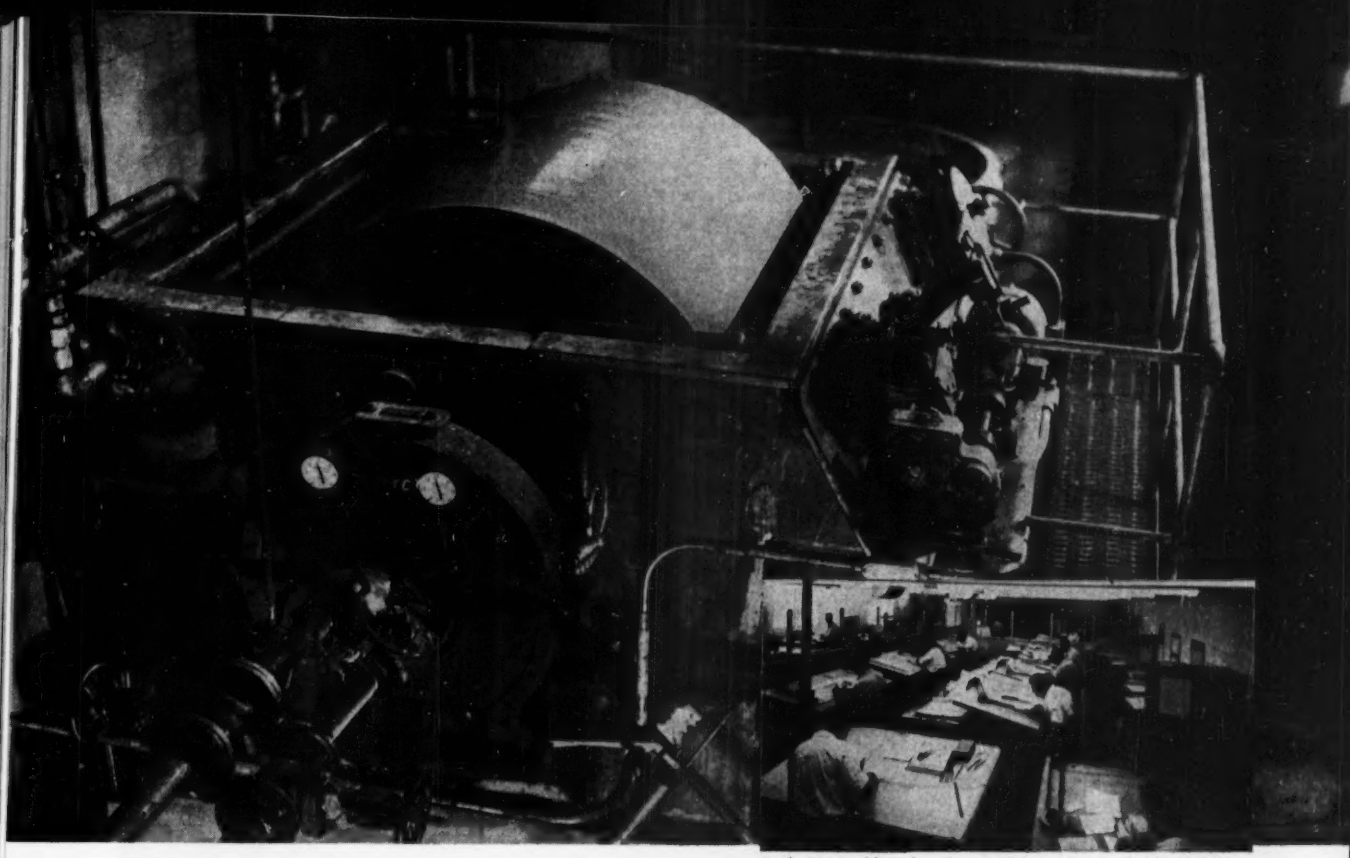


PILES at Windscale are slow-fission natural-uranium graphite-moderated. Cooling air is discharged from the 400-ft. stacks.



CONTROL where operators watch and control pile performance.

Continued on page 134 ▶



Each Eimco filter for the special process industries receives individual attention in engineering (above) and inspection (below).

Skill and Ingenuity at Work for You

Your Eimco filter is a product of skill and ingenuity wrought from more than half a century of service to the process industries.

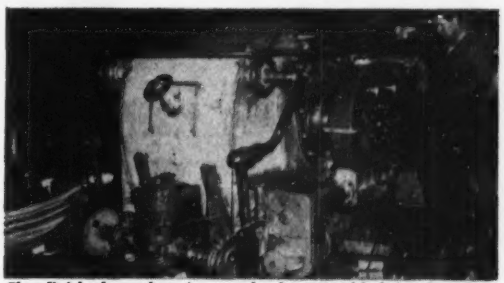
As a matter of fact, think about it — you wouldn't want it any other way. When you've worked out a process that requires the culture or slurry to be handled *just so* to produce your laboratory results, you can't afford to recommend anything but the finest equipment all the way through the plant.

Your finest product in pressure or vacuum Filtration is an Eimco.

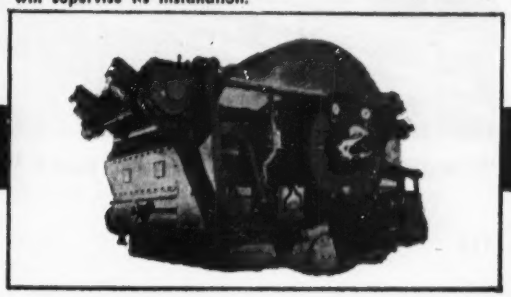
Costs — look beyond first cost — to the savings in higher recovery of values, greater clarity of filtrate, longer trouble free life in the equipment and in the case of the unit shown above, an Eimco precoating unit, about double the life of one precoat.

Write for information on the finest filters available anywhere to The Eimco Corp., P. O. Box 300, Salt Lake City 10, Utah.

Skilled mechanics with a field knowledge of filtration problems machine and assemble your specialized Eimco filter.



The finished product is completely assembled in the shop even if dismantling is necessary for shipment. An Eimco man will supervise its installation.



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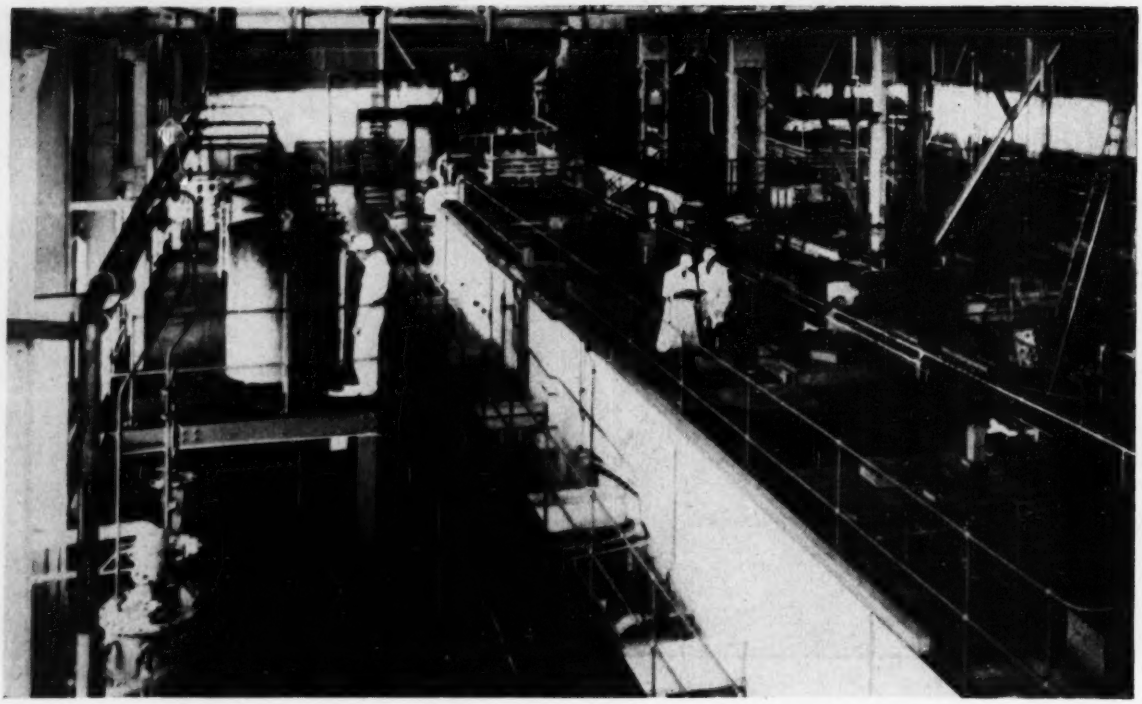
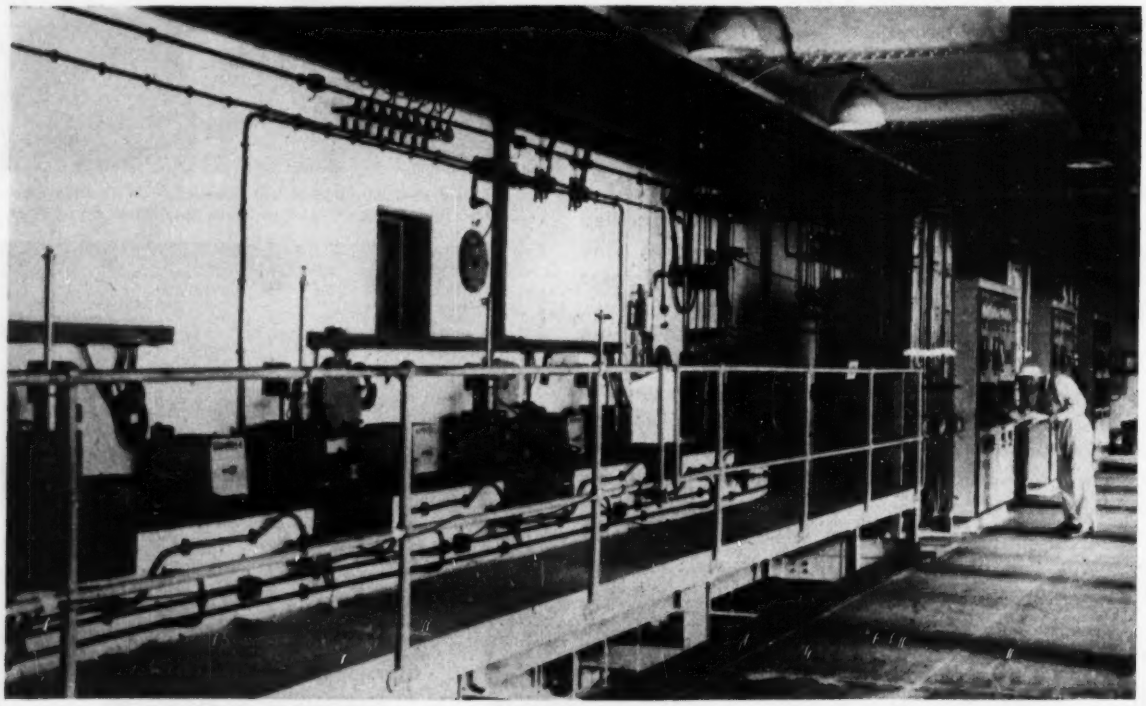


INSIDE the Windscale uranium purification plant where solution from primary separation is purified for return to Springfields.



WORKING DECK at the primary separation plant at Windscale where ounces of plutonium are separated from tons of pile slugs.

Continued on page 136 ▶

Case No. 63

Kemp Oriad Dryer Gives "Most Satisfactory Service" Guarding Spencer Control Board

How Kemp assures round-the-clock operation at Spencer Chemical

The Spencer Chemical Co., Charlestown, Ind., operates 24 hours a day, 7 days a week, making nitrogen compounds for the fertilizer industry. Heart of this operation is the master instrument board that controls all plant processes. These instruments are operated by compressed air, which must be dried to prevent rust and corrosion within the controls.

Kemp Offers Continuous Protection

Spencer uses a Kemp Oriad Dryer to dry all the air required and completely protect the delicate instruments from moisture damage. Since its installation in 1950, this Kemp unit has needed no service of any kind. And Spencer is delighted with Kemp's ease of operation! Mr. N. S. Whitaker, Works Manager, commenting on Kemp's "most satisfactory service," says, "Operation is simplicity itself. All we have to do is switch a lever once a week. Capacity is ample for one week of maximum flow, on a 24-hour 7-day operation."

Kemp Dryers for Every Purpose

Kemp offers a variety of dryer models to meet all problems. Designed to dry air to sub-zero dew points at low cost, these efficient dryers embody the engineering knowledge gained from Kemp's many years of experience. They are available with manual, semi-automatic, or fully automatic tower reactivation. In addition, Kemp will prescribe the proper desiccant for each specific drying job. If you have a problem involving the drying of air, gases, or liquids, contact Kemp engineers now.

Only operation required on Kemp Oriad Dryer is moving lever once a week to switch flow of air to second column. First column is reactivated by heat during the week.

***For more complete facts and technical information, write for Bulletin D-27 to:* THE C. M. KEMP MFG. CO., 405 East Oliver Street, Baltimore 2, Md.**

KEMP OF BALTIMORE

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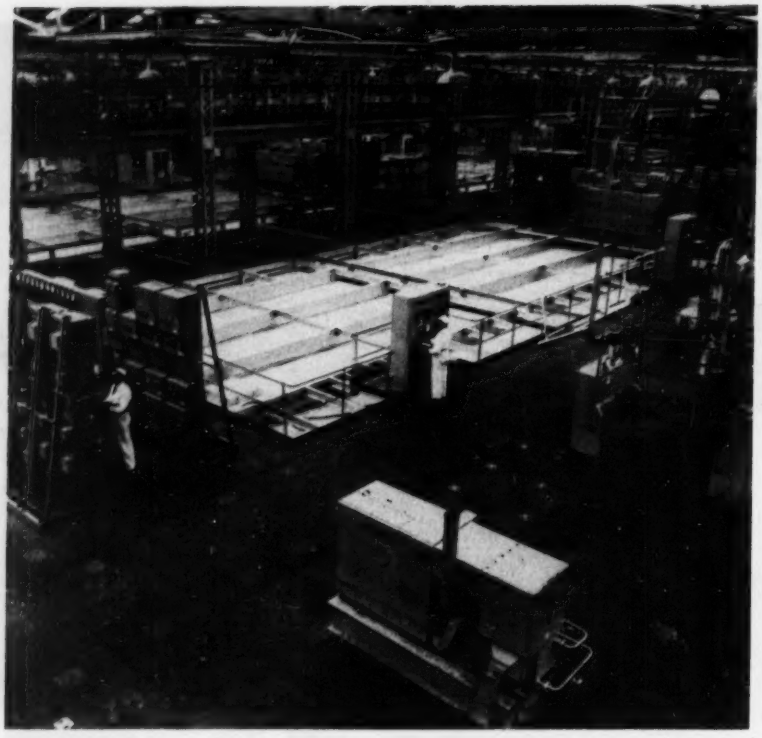
CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • INERT GAS GENERATORS
SINGEING EQUIPMENT



CONTROL DECK above the cells in the gaseous diffusion plant at Capenhurst.

CORRIDOR between two rows of diffusion cells. The process gas is alpha active.

OF ALL the engineering projects undertaken in Britain since the war, one of the largest was the building of three working units of their atomic energy organization. And it is now possible to reveal something of the work.

▶ **Uranium**—Hard, dense, ore gray is crushed, ground, slurried and dissolved by a warm acid mixture in stainless steel cascade dissolvers.

Barium carbonate precipitates out radium and other metals. Hydrogen peroxide precipitates uranium oxide.

Crude oxide is dissolved in nitric acid. It is extracted with ether and the pure uranyl nitrate is returned to the aqueous phase by washing.

Ammonium diuranate is precipitated from the purified uranyl nitrate. This brilliant yellow solid is filtered out and converted to metal in two stages: conversion to uranium tetrafluoride in an electric furnace; reduction with metallic calcium. Sequence of steps then becomes: remove billet, clean off slag, sample for analysis, remelt, vacuum cast into a rod, finish and machine the rod and put it into an aluminum can.

Lest this staccato listing of steps give you a false impression of simplicity, consider that the comparatively easy canning process involves more than 50 operations.

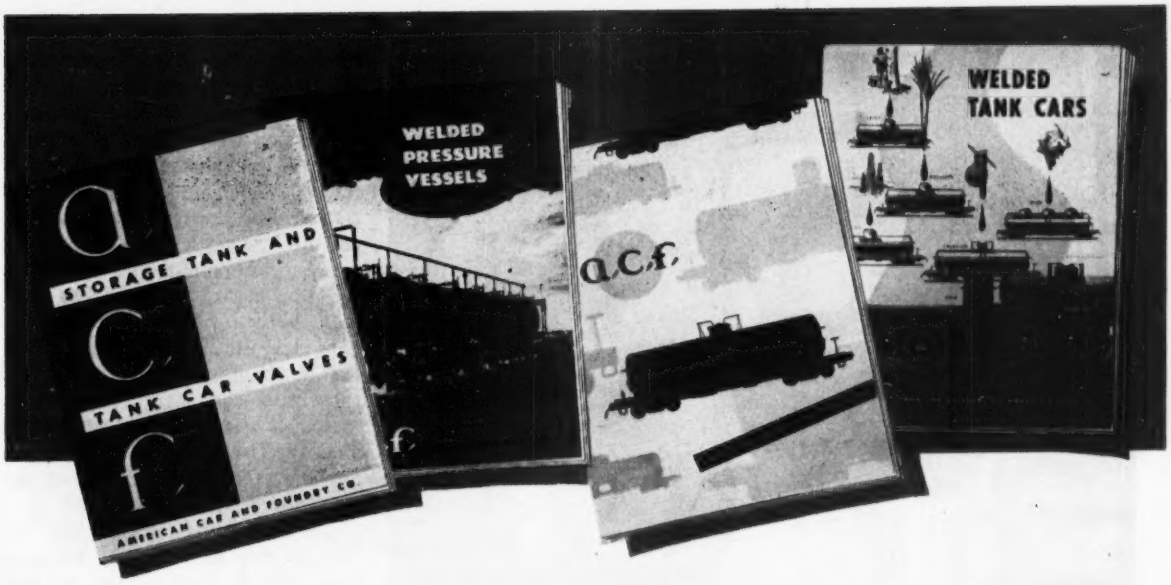
▶ **Plutonium**—The uranium cartridges are shipped some 80 miles to the two production piles at Windscale.

Plutonium made from U-238 is also obtained by countercurrent solvent extraction using ether. The irradiated slugs of uranium are pushed out of the pile and dropped into water. They're allowed to age, then dissolved in nitric acid (several tons of acid for a few ounces of plutonium).

▶ **Gaseous Diffusion**—Several thousand stages are required in the gaseous diffusion plant at Capenhurst where uranium 235 and 238 are separated. The whole system with its thousands of joints and miles of pipes is vacuum-tight because the alpha-active uranium hexafluoride is precious, dangerous and easily contaminated.

Enriched 235 and impoverished 238 are removed at either end by freezing with liquid nitrogen.

▶ **Second Stage**—In Britain's future are the design and construction of a prototype fast reactor and a gas-cooled power converted. —End



Four authoritative booklets about:

- **Storage Tank and Tank Car Valves** . . . tells why a.c.f. Valves last longer, flow faster, maintain trouble-free service. Complete specifications of all types available for various ladings and uses.
- **Welded Pressure Vessels** . . . tells the most important factors to consider before purchasing *any* tanks, valves, etc. Gives blueprints and specifications. Tells about manufacturing techniques . . . what they mean to the buyer!
- **Tank Car Classifications for Lading** . . . This is the only reference of its kind! Tells at a glance which tank car to use for any given lading. Also blueprints and latest ICC regulations as they relate to tank usage.
- **Welded Tank Cars** . . . Contains pictures and specifications of standard types for gasoline, liquid caustic soda, sulphuric acid and many other products. Illustrates advanced production techniques . . . blueprints of tank car and valves . . . latest materials for resistance to heat, moisture, etc.

Here, in one convenient place is a wealth of important factual information. Just the facts you'll want most before considering the purchase of *any* of these important products. Send for any or all.

There's an a.c.f. Representative near you to give you further details that are of particular interest. Write: American Car and Foundry Company, New York • Chicago • St. Louis • Cleveland • Philadelphia • Washington • San Francisco

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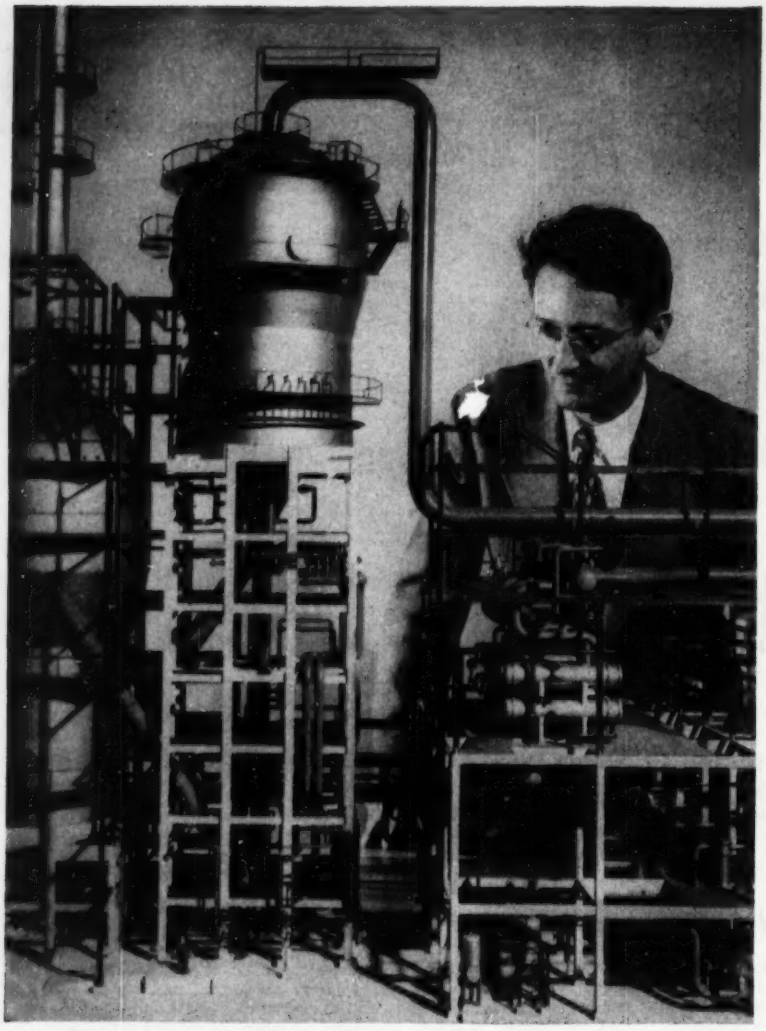


CAT CRACKER scale model is looked over by H. L. Isham, Shell Oil engineer.

Shell Oil Goes for Model

Shell Oil Co.'s big new catalytic cracking unit is going up at Norco, La. Playing a big part—a scale model being used in design, construction and training.

"A 3-D blueprint." That's what Foster Wheeler is using to engineer Shell Oil Co.'s new $42 million fluid catalytic cracking unit—now going up at Norco—designed to handle a total feed of 72,000 bbl./day of crude.

And the scale model is making a major contribution to fast and successful completion of the project; scheduled to start up sometime this summer.

Shell's model is not a toy. Nor is it meant just for display—although it certainly qualifies as a showpiece. It's an accurate, carefully constructed, 1:48-scale version of the actual unit—complete with valves on the process piping—built by Project Models Co. of New York City.

▶ **Important Part**—Three largest pieces of equipment represented on the model are the 39-ft.-dia., 87-ft.-high regenerator, where carbon is removed from the catalyst; the 36- x 72-ft.-high reactor, where crude charge will be cracked in contact with the catalyst; and the 26 x 124 ft.- high fractionator, where separation of the cracked charge will take place. The model is 8 ft. long, 4 ft. wide and 3 ft. 4 in. high.

Model cost? About $10,000—only a few hundredths of a percent of the value of the equipment represented.

Actually it is an "engineering model." This means that it plays an important role in the design, construction and operation of the plant.

The design phase is now past history for the Shell model. Made in New York in three sections for easy transportation, it is now out on the Norco construction site—aiding the construction and operating crews.

▶ **Construction**—Crews putting up the refinery are sold on the model. They are running into fewer headaches correcting blueprint errors. These errors were spotted and eliminated during the building of the model. And it's safe to say that the model is a big help in the planning and scheduling of construction operations.

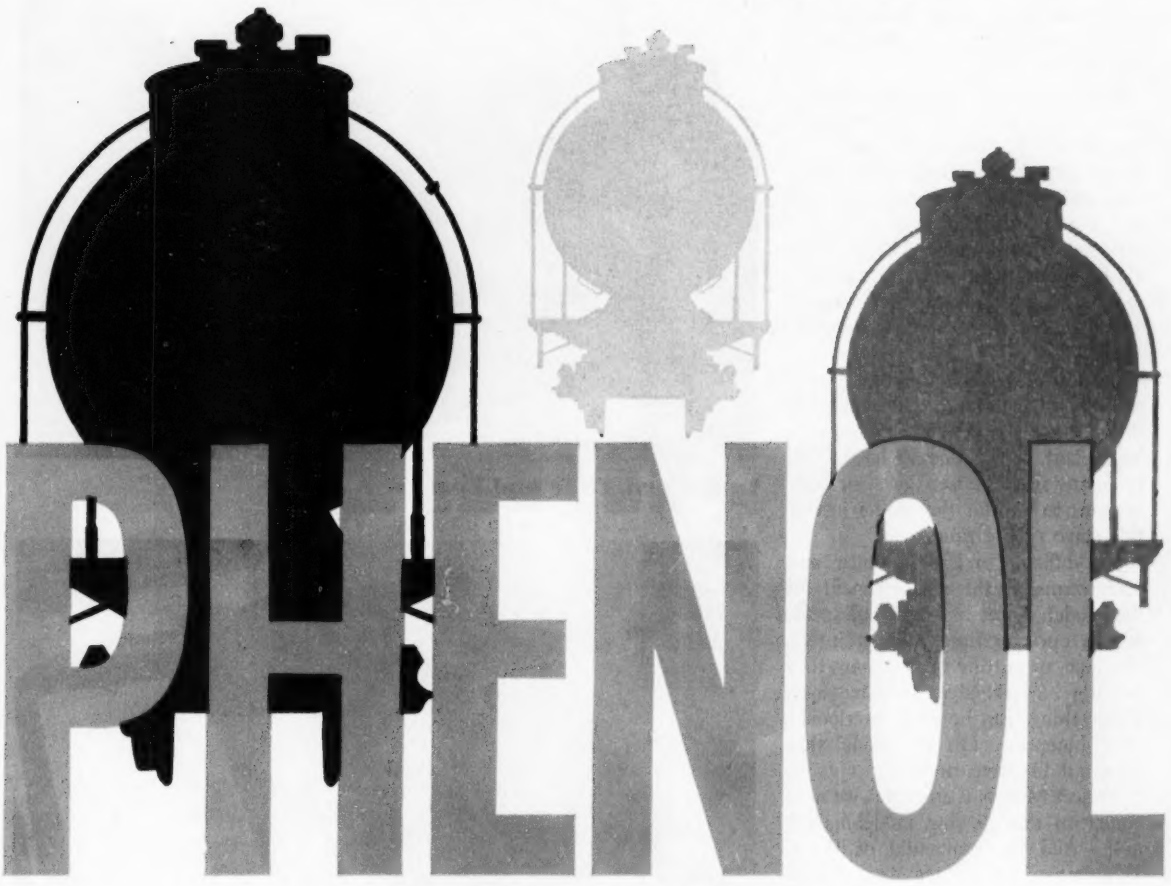
While construction goes on, operating crews are intently looking over the scaled-down version. Blueprints are also used (the model doesn't replace blueprints). But the model is serving as an excellent visual aid; giving the operators a good over-all picture of the plant, and pointing up important areas. This will be a big factor in getting the refinery operating on schedule.

Models have proved themselves in training before. Some time ago, an operator (not a Shell employee) went through an intensive period of training with a model. He was finally taken out to the plant. After a trip through the big unit he had only one comment—"gee, it's just like the model."

▶ **Model Birth**—The model had its origin during the early design stage of the Norco unit. Piping and structural details were added from and as the design drawings developed. All three groups—Shell, Foster Wheeler and Project Models worked in close harmony on the drawings and on the model.

Design groups like Foster Wheeler have used models before. But the

A BASIC *source of supply for...*



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Detergent Slurry	Naphthenic Acids
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Wetting Agents	Xylol
Cresylic Acids	Aliphatic Acid
Gas Odorants	Acetone
Lubricating Oil Additives	Hydroformer Catalyst
Sodium Sulfonates	Dispersant FO
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Consider the advantages Oronite can offer you as a true basic source of supply for Phenol.

Oronite has complete control of all raw materials which it uses in the manufacture of Phenol. Further, the Oronite manufacturing process does not require materials which have often been in short supply in the past.

With Oronite you are always assured of a dependable source of supply for Phenol—good service and product when you need it.

You will find the quality of Oronite Phenol the highest (fully meeting the U.S.P. specifications) and priced competitively.

Contact the Oronite office nearest you for further product and supply information.

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30 Rockefeller Plaza, New York 20, N. Y. • 600 S. Michigan Ave., Chicago 5, Ill.
Mercantile Securities Building, Dallas 1, Texas

Norco project is another indication of a strong trend: accurate scale models are becoming essential working tools in the engineering of modern, complex process plants.

During design, errors were quickly picked up by the model and the drawings corrected. These errors—and some design groups are reluctant to admit this—are more or less inevitable. Shell and Foster Wheeler have confirmed what model makers have been claiming for many years. It's a lot easier to spot and correct them (and simplify design) on a three-dimensional scale model.

► **Savings**—A small item? Not if you consider all the money and man-hours that go into the design drawings of a large plant. There doesn't have to be too many simplifications or error eliminations to pay for the model just at this stage of the game.

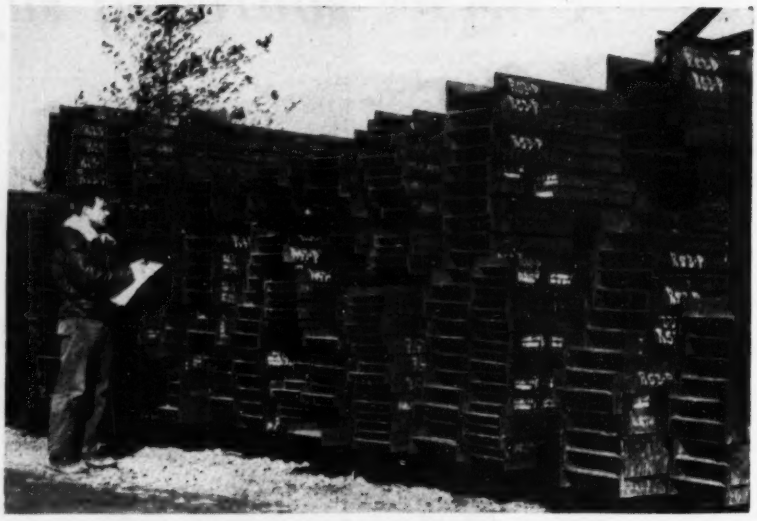
It's difficult to list, in dollar and cents terms, all the design benefits of the model. Some are intangibles: saving an operator from walking into a low pipe, or putting valves where they can not be reached in an emergency. These things can be easily overlooked on a blueprint. On the model they stick out like sore thumbs.

Project Models is an aggressive newcomer to the growing model-making field. And the brainchild of H. A. Wanderman, a former design engineer. Working on the design of complex refineries convinced Wanderman of the need and future possibilities of models. He decided to devote full time to making them, went into business in 1952.

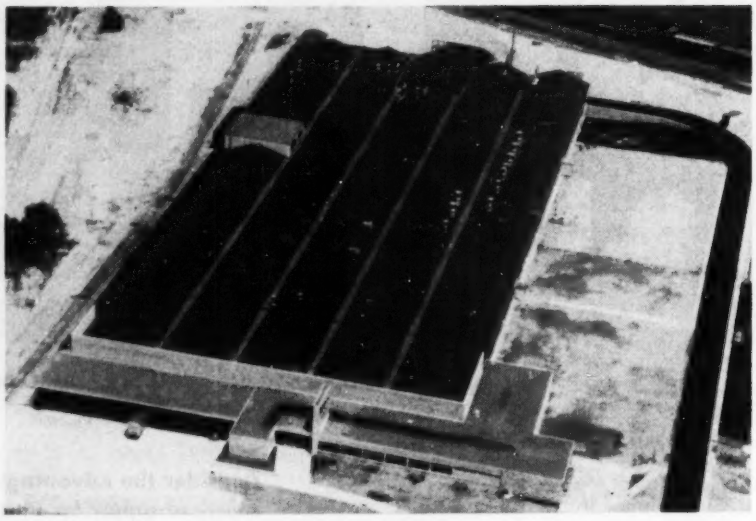
► **Norco Details**—The Norco catalytic cracker is the fourth unit built by Foster Wheeler for the Royal Dutch/Shell Group. Other units are at Houston, Tex., Pernis, Holland and Stanlow, England.

Shell engineering research and development worked out the basic design. Scheduled for completion in midyear 1954, it will be one of the largest cat units ever constructed. Incorporated is some of the most advanced thinking in the design of high capacity catalytic cracking process units.

Any statistics on the refinery are impressive. The unit is big, complicated and expensive. The model is paying off here. But it's a good bet that scale models are also paying for themselves on smaller and less expensive plants.



In Record Time and Low Cost . . .



Pre-Engineered Sections Become . . .

Store-Bought Buildings

Chemical industry becomes a big buyer of packaged buildings. Major reasons are their low cost, quick delivery, ease of construction, safety, and flexibility.

The advantages of standard or packaged building units are making them very popular in the chemical process industries. Use of these buildings has now reached the point where one of the largest suppliers of prefabricated building units credits the chemical industry with the biggest share of his orders during 1953.

We couldn't get a specific total for chemical process industry expenditures on standard buildings. The manufacturers lump them together with purchases by oil companies and petro-

now "on stream"

the FOSTER WHEELER process for -

ammonia synthesis

TEXACO PARTIAL OXIDATION The new non-catalytic oxidation process for the low-cost conversion of hydrocarbons (gaseous or liquid) into Carbon Monoxide and Hydrogen. This process, now in commercial operation, represents the latest development in synthesis gas technology.

FOSTER WHEELER LIQUID NITROGEN WASH Design improvements in heat-exchange and liquid Nitrogen contact insure high-purity Hydrogen for subsequent Ammonia synthesis.

CASALE AMMONIA SYNTHESIS Featuring jet-recycling of unconverted feed, Casale, with over 40 plants operating throughout the world, is the lowest-cost synthesis process for the production of liquid anhydrous Ammonia.

Two Ammonia producing plants recently placed "on stream" and four more are in various stages of design and construction. These six plants have a rated capacity of **1000 Tons per day.**

Write for **Bulletin O-54-1**

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK

Construction Equipment: A crane and . . .

A crew with wrenches.

chemical producers. But you'll get some idea of the widespread realization that packaged buildings offer advantages which custom buildings don't by scanning the table below. We list companies that are representative of packaged building purchasers in 1953.

Some 1953 Customers

American Cyanamid Co.
Carbide and Carbon Chemical Co.
Columbia Southern Chemical Co.
Commercial Solvents Corp.
E. I. du Pont de Nemours & Co.
Geigy & Co.
Hercules Powder Co.
Mathieson Chemical Co.
Merck & Co.
Nitrogen Div. (Allied Chem. & Dye)
Rohm & Haas Co.
Stauffer Chemical Co.
Victor Chemical Works
Western Condensing Co.

Naturally there are reasons why a factory fabricated building is preferred instead of made-to-order or custom buildings. The major advantage is price; but the quick availability of price information, pre-engineering, single supply source, speedy erection, safety, flexibility, the possibility of future additions and portability all contribute to a decision in favor of prefabrication.

▶**Low Definite Cost**—Low cost isn't any mystery. Standardized parts are cheaper whether you're buying a wrist watch or a factory building. And you don't have to guess about the price. Just look it up in a catalog.

We gathered a few cost figures. Bare steel buildings run as low as $0.75/sq. ft. Cost of covering, either with aluminum or asbestos, raises the average to $1.25/sq. ft. Then add $0.50 for the concrete slab, another $0.50 for erection and your total is about $2.25-$2.50/sq.ft.

Often this is a saving of about 25-30 percent of usual construction costs. One leading insecticide manufacturer told us about his plant expansion near Baltimore.

"By using a standardized steel structure it cost us only 71 percent of our usual construction bills."

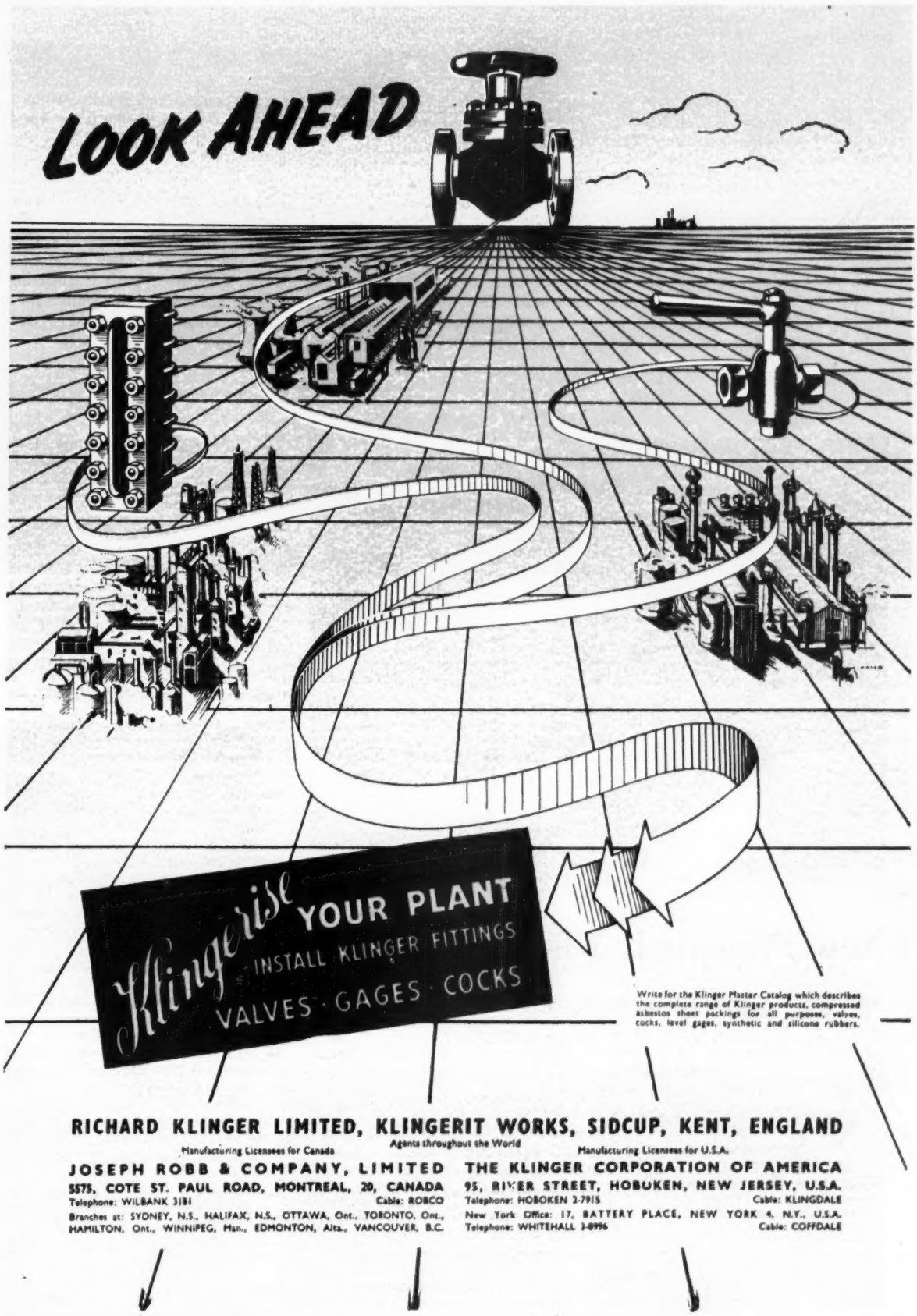
▶**Quick completion**—Next in importance is completion time. In 1947, the delivery of packaged buildings took up to 26 weeks. In 1952, delivery time was cut to 16 weeks. Today most suppliers can get all the required parts to your building site in less than a month.

Last year a chemical plant in New Jersey was destroyed by a fire. A complete replacement building arrived at the site before the debris could be cleared away.

But delivery is only part of the quick completion story. If we can believe one manufacturer's press releases, putting up a standard building is like putting together something in your own basement. It's even easier than that. It's like playing with your son's Erector set. All you need is a crane for lifting the fabricated units into position and a couple of wrenches to tighten the bolts in their pre-punched holes.

▶**Look Out for Unions**—This may be over-simplifying it a bit, but probably the average maintenance crew in a chemical plant can tackle a job like this. If not it's a relatively simple task for a local contractor to handle. We are advised by *Construction Methods & Equipment*, a McGraw-Hill publication, that some unions have objected to quick construction of standardized buildings.

On one job where the work could



Write for the Klinger Master Catalog which describes the complete range of Klinger products, compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers.

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have been finished in less than one day, the actual time of construction was stretched to nine full days. This coincided with the time which would have been required to put up the usual kind of building.

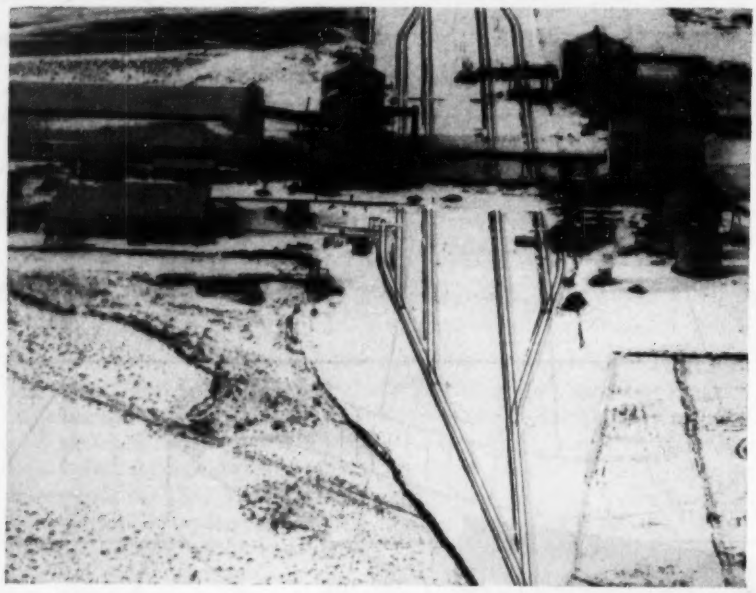
▶ **Safety**—Pre-engineered buildings are easily ventilated. Many of them include roof ventilators.

The comparative light weight of metal covering compared to concrete reduces explosion damage. And in many cases, chemical companies have preferred to use corrugated asbestos cement coverings in place of ribbed steel and aluminum.

▶ **And They're Flexible**—Other advantages include choice of doors, windows, panels and span width. You can knock down a side wall and add on an extension. In fact the entire structure can be knocked-down, shipped and re-erected at another location.

A leading supplier advised us as follows: "One 40×100×14 ft. building has been erected and disassembled four times. Originally it was purchased by a federal agency for use on the West coast. It is now located near Pittsburgh, Pa."

We are grateful to the following manufacturers for supplying information for this survey: Behlen Mfg. Co., Columbus, Neb.; Butler Mfg. Co., Kansas City, Mo.; Luria Engineering Co., Bethlehem, Pa.; Macomber Inc., Canton, Ohio; Steelcraft Mfg. Co., Rossmoyne, Ohio.



New Phosphate Plant for Utah

Phosphate fertilizers for western farmers are now being produced in the new $5 million plant of Western Phosphates, Inc., at Garfield, Utah. The plant has started production of phosphoric acid and triple superphosphate in pellet form. Ammonium phosphate production begins this spring; it will also be pelletized.

Initially, annual production of phosphate fertilizers will be about 90,000 tons. Of this total, triple superphosphate will represent the largest tonnage. These fertilizers will be distributed in the western United States by the Wilson & George Meyer & Co., Intermountain.

Jointly owned by American Smelting & Refining Co., Kennecott Copper Co. and Stauffer Chemical Co., the new company, Western Phosphates, Inc., will operate as a separate organization instead of as a subsidiary of any of the three stockholding companies. Stauffer designed and built the plant because of its experience in the manufacture of single superphosphate and other agricultural chemicals.

Phosphate rock for the operation is shipped from Idaho and Wyoming, where Stauffer owns unexploited reserves in addition to the operating phosphate properties. Sulfuric acid, the other essential raw material, is delivered by pipeline from the plant of Garfield Chemical & Manufacturing Co., jointly owned by American Smelting & Refining and Kennecott Copper.

Convention Calendar

American Chemical Society, national meeting, Municipal Auditorium, Kansas City, March 24-April 1.

American Oil Chemists' Society, annual meeting, Plaza Hotel, San Antonio, Tex., April 12-14.

Southern Industrial Wastes Conference, Shamrock Hotel, Houston, April 21-23.

Industrial Research Institute, award dinner, San Francisco, April 22.

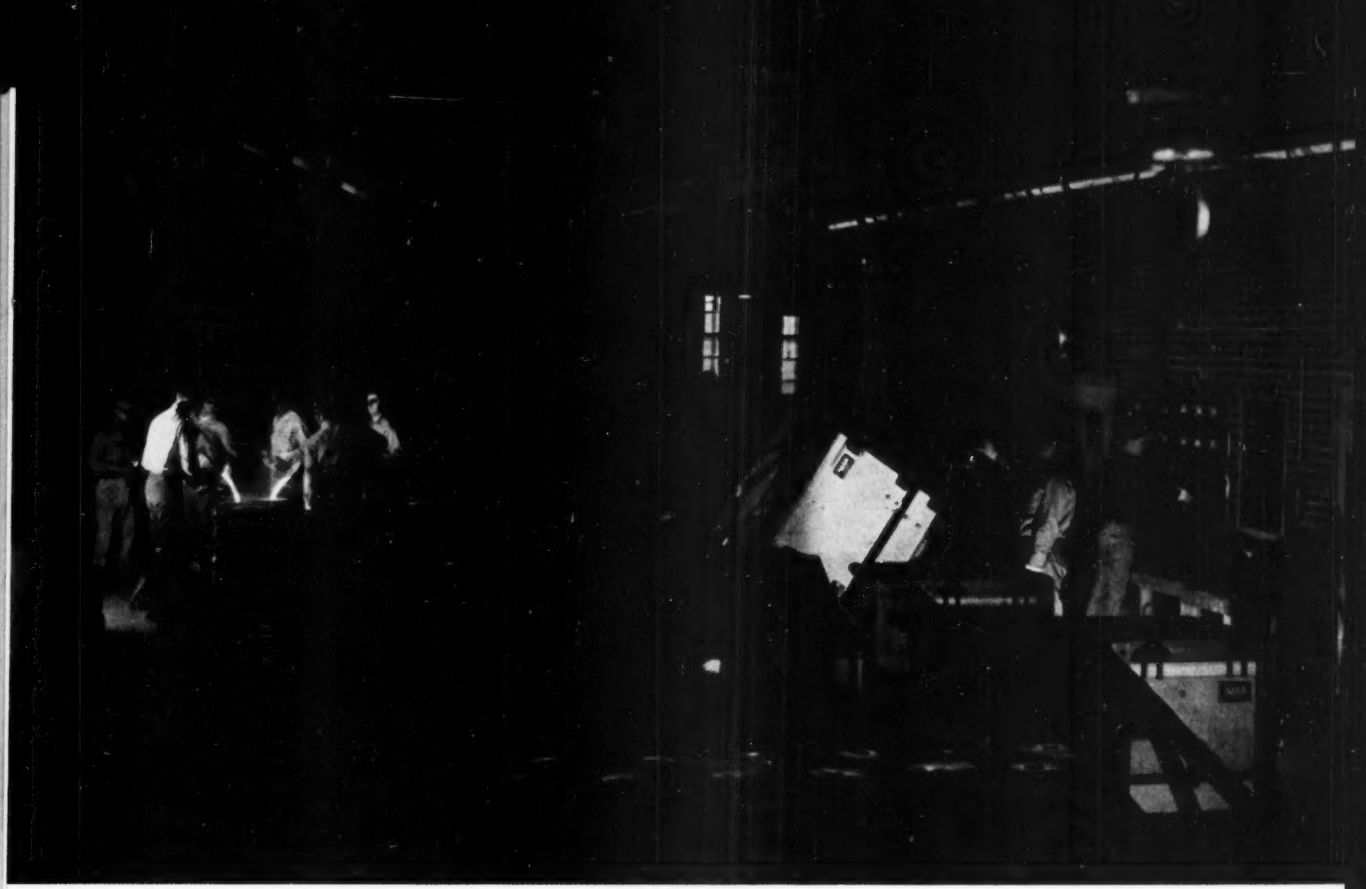
Association of Consulting Chemists & Chemical Engineers, symposium and banquet, Belmont Plaza Hotel, New York, April 27.

Air Pollution Control Association, annual meeting, Patton Hotel, Chattanooga, Tenn., May 3-5.

Chemical Specialties Manufacturers Association, mid-year meeting, Netherlands Plaza Hotel, Cincinnati, May 23-25.

Manufacturing Chemists' Association, joint meeting with Synthetic Organic Chemical Manufacturers Association, Green Brier Hotel, White Sulphur Springs, W. Va., June 3-5.

For more WHAT'S HAPPENING. . . . Page 384



MODERN EQUIPMENT and closest attention to every casting detail enable new Aloyco foundry to turn out the finest corrosion-resistant valve castings made.

New Aloyco foundry helps process industries in record expansion

PATTERN SHOP. In this well-equipped shop seasoned craftsmen make extremely accurate wood or metal patterns for valves of any size or complexity

During 1954, almost half the nation's total investment in new plants and equipment will go into the chemical and petroleum industries.

To meet their unprecedented needs for processing equipment, our new specially-equipped foundry will substantially increase the production of Aloyco corrosion-resistant valves.

For 25 years, Aloyco, the world's largest specialist in high alloy valves, has been helping the chemical process industries master valve corrosion problems. Alloy Steel Products Co., Inc., 1301 West Elizabeth Avenue, Linden, New Jersey.

Plants: Linden, N. J., Bloomfield, N. J., Elizabeth, N. J.

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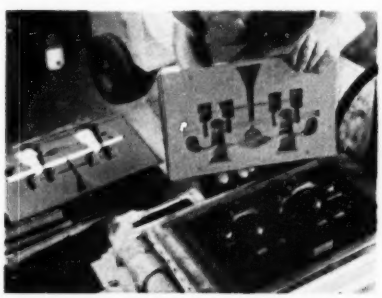
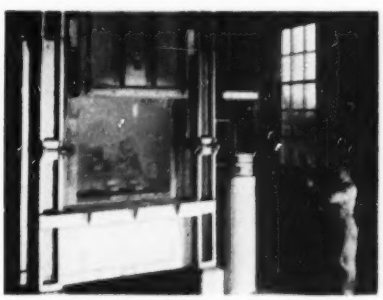


SHELL MOLDING. Up-to-date shell molding facilities assure users of the greatest contour accuracy in castings for small and medium-sized Aloyco valves.

INSPECTION AND HEAT STAMPING. Castings are carefully inspected, their "pedigrees" stamped in. Any not 100% perfect are remelted, never welded or patched.



HEAT TREATING. After cleaning, all Aloyco austenitic type castings are heat treated and water quenched to insure maximum corrosion resistance.

What's being done with Plastic Pipe these days?

A great deal. Consider for example Uscolite® pipe, manufactured by United States Rubber Company. Uscolite is tough, rigid, lightweight, corrosion-resistant, makes a tight, firm joint.

When you say Uscolite is tough and strong, just how tough and strong do you mean?

Won't break if dropped or hammered. It needs no coddling. Can be set and threaded on the job with standard pipe tools. Stands up under the most severe conditions.

What will Uscolite pipe carry?

Uscolite has excellent chemical resistance. It's especially recommended for carrying corrosive chemicals and materials sensitive to contamination. It's valuable for piping through highly humid and corrosive atmosphere. It works under the most severe conditions.

Is Uscolite a new product?

No. Uscolite pipe and fittings have been proved by years of service in thousands of installations in dozens of different industries.

Is Uscolite difficult to install?

On the contrary. It is available in both the standard and the extra-heavy wall iron pipe sizes. It is easy to cut and thread with standard equipment and install without special precautions. The pipe can be drilled, tapped, sawed and machined.

Is the Uscolite line complete?

Yes. It includes elbows, tees, flanges, couplings, reducing bushings, caps, valves—everything to make a complete pipe assembly.

How do I know if I can use Uscolite in my own business?

The odds say overwhelmingly that Uscolite pipe and fittings can save you money. Call on any of our 26 District Sales Offices, each staffed with engineers, to help solve any of your corrosion problems. Or see any of our selected distributors, or write to address below.

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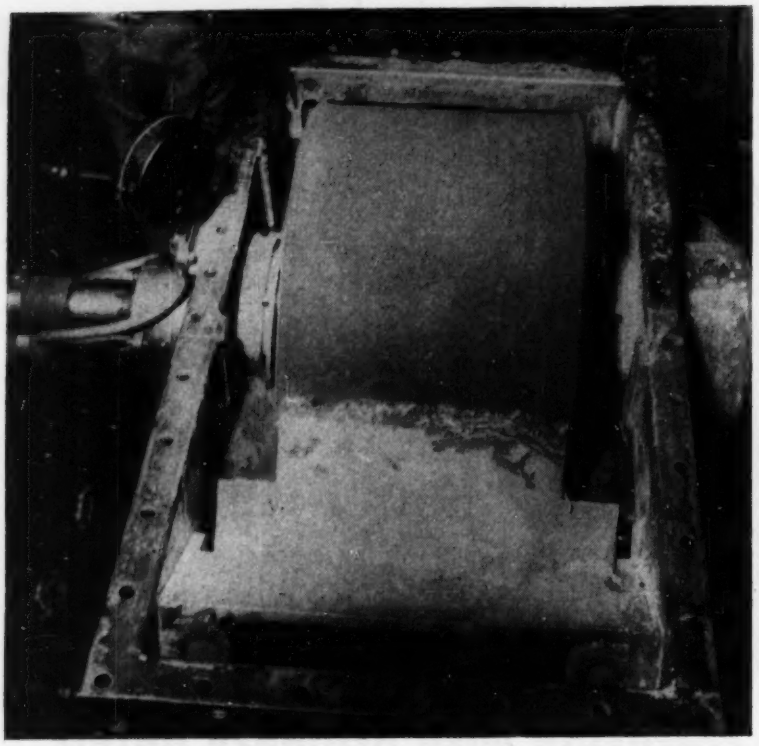

ROTARY VACUUM FILTER dewaters ferric hydroxide when precoated with . . .

WOOD CELLULOSE filter-aid (167×).

Filteraid Gives Clarity With High Flowrate

Made from wood cellulose in several particle sizes, this unusual product contributes essentially no contamination, even at temperatures well over 350 deg. F.

The introduction of new filteraids and the increased knowledge and acceptance of materials that have been available for some time are gradually making the application of filteraids to clarification filtration both more useful and more complex.

Solka-Floc, a finely divided wood cellulose produced by the Brown Co., is an example of a filteraid that's finding its way into a rapidly growing number of applications with all types of filtration equipment, including rotary precoat filters (above). Basically different in almost every respect from the inorganic materials currently available, it has helped solve clarification problems previously considered impossible.

▶ **Strike-Born**—The product got its biggest boost during the diatomaceous earth strike in 1952. Experimental work at that time, aimed at finding a way to stretch existing filteraid supplies, surprised many engineers with the fact that mixtures of wood cellulose with other filteraids often give better results than does either material by itself.

Following up these results, the Brown Co. technical service department has now developed systematic methods for studying clarification filtration problems of potential customers.

▶ **Negligible Contamination**—Solution of many of these problems depends on the chemical properties of Solka-Floc. Being nearly 100 percent pure cellulose, it produces no silica contamination and negligible inorganic contamination of any kind. It is essentially ashless. Also, content of ether- and water-soluble components is very low, consisting mainly of various sugars.

Under conditions of chemical decomposition, the primary product of cellulose is sugar. Thus, filter cake containing it can be burned readily or used as animal feeds, if desired. The filteraid can also be removed by acid hydrolysis.

This cellulose is resistant to alkali attack at all concentrations and at

Celite Filtration assures perfect clarity—

adds eye appeal and buy appeal to food products

TO GIVE foods and beverages that extra quality which results in more sales appeal, leading processors depend on Celite Filtration. The Celite method provides perfect clarity at high production rates.

Celite Filtration is *efficient*. It removes even the finest suspended solids. Moreover, Celite Filtration is *economical*. It may be used with any type of conventional filter, it is almost automatic, and only unskilled labor is required for routine operation.

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A Johns-Manville Celite Filtration Engineer will gladly discuss the advantages and use of Celite in your product or production process. For his services, without obligation, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE PRODUCTS

Johns-Manville CELITE INDUSTRY'S STANDARD FOR FINEST FILTRATION

These Products Made News This Month

Page and code number

Filteraid made from wood cellulose....148A
Cleaner for styrene....150A
Chlorinated rubber coating material....150B
Masonry water proofer....152A
Flexible foam....152B
Resistant ethylene polymer....152C
Data on chlorobenzene isomers....154A
Herbicide test....156A
Plasticizing polyol....156B
Flowable synthetic rubber....156C
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Page and code number

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Three polyester resins....158D
Strippable coating....160A
Copper-to-plastic adhesive....160B
Oxidizing agent....160C
New grade of vinyl resin....160D
Systemic insecticide....160E
Wet strength resin....160F
Finish for acrylic plastics....160G
Latex adhesive....160H

▶ For more detailed information on any of the items in this department, just circle the code number on the reader service postcard inside the back cover.

temperatures up to 120 deg. F. It is resistant to organic acids and to dilute mineral acids, depending on temperature and time of contact. It is successfully used as a filteraid at temperatures up to 400 deg. F. in applications where it must retain its physical properties for days.

Typical materials now being filtered through Floc because of these chemical properties are alkalis, acid plating baths, syrups and vegetable oils containing solids valuable as animal feeds, plus many metallurgical and other slurries.

Because of the colloidal character of cellulose fiber, the product is often effective as an absorbent for undesirable impurities. The electrical charge acquired when it is in contact with liquids having dielectric constants different from cellulose sometimes coagulates oppositely charged colloids. In water it is strongly electronegative and tends to absorb positively charged particles.

For example, it's frequently used to remove iron from caustic solutions and emulsified oil from water. When dried, it is also effective for the removal of water from a number of organic liquids.

▶ **Won't Hurt Equipment**—The physical properties of Solka-Floc are also important. It is completely non-abrasive to pumps, valves, instrument components, filter screens and cake handling equipment. Expensive slurry feeding systems are unnecessary. And because of the low percentage of voids in the cake, it retains less valuable liquid than competing products.

The coarser grades of Floc are predominately fibrous in nature. This means that filter cakes made with them are extremely resistant to "bleeding" and cracking, despite pressure fluctuations and interruptions, and they are easily removed from batch equipment. Precoating with the product is the easiest way to dress a filter press with paper.

▶ **Keeps Flowrates High**—The factors determining clarity and flowrate in filteraid work are complex and difficult to measure. But work done with a number of different filteraids has conclusively disproved the commonly accepted notion that flowrate can only be improved at the expense of clarity and clarity at the expense of flowrate.

Relative effectiveness of filteraids depend on the size and shape of the solids to be removed, the viscosity of the liquid and the colloidal nature of the system. And according to its makers, Solka-Floc is so different from all other filteraids available that it frequently can give combinations of high flowrate and sharp clarity not otherwise possible.—**Brown Co., Berlin, N H.** **148A**

Cleaner for Styrene

Used prior to metallizing, leaves no residue when air dried.

Latest use for an established liquid cleaner called Poly-Kleen is in preparing polystyrene surfaces to secure maximum adhesion of the lacquer coat used prior to metallizing. When removed from molding machines, styrene is often found to be soiled with foreign matter. Unless it's thoroughly cleaned, metallizers have production losses and rejects.

The new product effectively solves this problem because it's a solvent type liquid that quickly removes grease, oil stains and mold lubricants, including silicones which are extremely hard to remove from anything. No marring or crazing results, even on the thinnest polystyrene stock.—**Schwartz Chemical Co., 326 W. 70th St., New York, N. Y.** **150A**

Chlorinated Rubber

Gives a coating that withstands severe corrosive conditions.

A formulation of unmodified chlorinated rubber has been developed to meet plant corrosion conditions where the ordinary lines of chlorinated rubber finishes have not been sufficiently chemical resistant. Called Erchlor

PIONEERS IN PETROCHEMICALS. Since the early 1920's Carbide and Carbon has been the trailblazer in what is now known as the "Petrochemicals Industry." In 1937, Carbide and Carbon put into commercial use its own process for the manufacture of ethylene oxide by direct oxidation. Since that time important improvements and modifications have been made in the original process and equipment which have resulted in marked technological advances. The development of the direct oxidation process is only one instance of Carbide and Carbon's accomplishments as "Pioneers in Petrochemicals."

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Rely on CARBIDE for this important chemical building block. Why? Because you can be sure that after 28 years of experience in producing ethylene oxide, CARBIDE can offer you consistent, high-quality material in the quantity you need—when you need it.

If you use ethylene oxide, call or write the nearest CARBIDE office for your copy of "Operating Procedures for Handling Ethylene Oxide." Ask for Form 7618. For information on ethers or other oxides, request Form 4764.

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1900, it is recommended for use on brown stock washers in pulp mills, on pumps and motor bases and for outside structures and machinery.

For hot service in strong caustic areas, such as brown stock washers, no primer is needed. For outdoor structures exposed to strong chemical exposure, red lead primer is suggested. Exterior equipment requires a quick-drying chromate primer.

The coating is easy to apply by brush and can be thinned for spray application. It is nonflammable and can be used on metal, wood or concrete.—**Earl Paint Corp., Utica 2, N. Y.** **150B**

Masonry Water Proofer

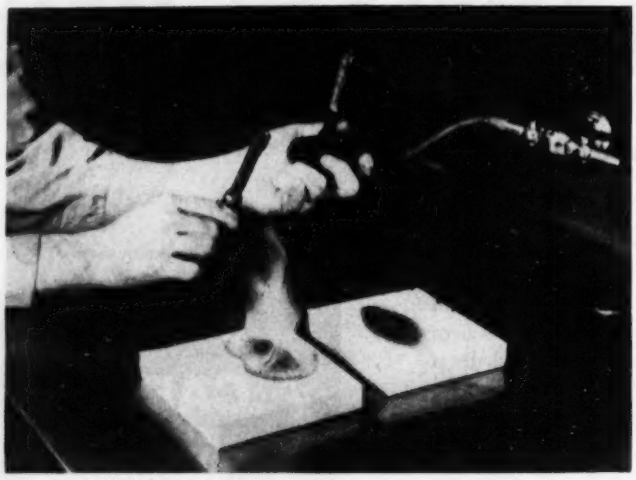
Keeps limestone from cracking or chipping under severe weathering.

Tests underway at Kansas State College indicate, according to Dr. F. C. Lanning of the Dept. of Chemistry, that masonry walls can be effectively waterproofed with sodium methyl siliconate (SC-50), by G.E.

Lanning's studies were carried out in four limestone quarries. These included Cottonwood limestone, Neva limestone, Fort Riley limestone and Funston limestone. After treatment, none of these absorbed much moisture and all were quite resistant to ferric chloride staining.

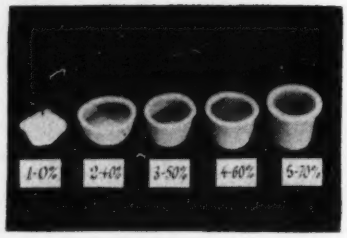
Water soaked stones were put through a severe freezing-thawing test, repeated 10 times, with practically no damage to the stones coated with the siliconate. No cracking or chipping was observed in the raw Funston limestone, although there was considerable cracking and chipping in two of four layers of Cottonwood stone.

At the end of the test, it was found that the coated stones absorbed moisture somewhat more readily, indicating that the resin film was slowly breaking down. More tests are needed to determine just how durable the resin is.—**General Electric Co., Silicone Products Dept., Waterford, N. Y.** **152A**



Flexible foam breathes, is self-extinguishing

A new process, using plastisols based on Bakelite's vinyl resins, produces a soft, flexible, cured foam that is easily fabricated at a price comparable to foam rubber. The foam breathes because gas mixed with the plastisol provides uniformily distributed interconnecting cells. Abrasion and corrosion resistance are excellent and while foam rubber burns furiously after flame is removed (above, left), foam plastisol only scorches under flame, is self-extinguishing after it's removed.—Elastomer Chemical Corp., Newark, N. J. **152B**



Ethylene Polymer

Greatly reduces heat distortion of commercial polyethylene when blended in above concentrations.

Marlex 20, a unique ethylene polymer with a predominant polymethylene structure, is now being field-tested. By itself, the compound is resistant to attack by concentrated hydrofluoric, hydrochloric and sulfuric acids at room temperature. It is also virtually unaffected by common organic solvents at room temperature, except that it is swollen by chlorinated, aliphatic and aromatic hydrocarbons.

Biggest use will probably be in blends with flexible polyethylene, where it imparts increases in softening point, heat distortion temperature, melt index, hardness and tensile strength. Addition of 50 percent Marlex 20 to polyethylene "A," for example, raises the softening point from 222 to 240 deg. F., the heat distortion temperature from 111 to 133 deg. F.

Household and industrial containers made from these blends will hold their shapes after repeated washings in hot water. Also, rigidity is increased at normal temperatures. This means you'll need less resin in applications where wall thickness is determined by the desired degree of rigidity.

Another important use for the product is expected to be in blends with paraffin or vegetable waxes. When the components are blended at about 250 deg. F and cooled rapidly, a homogeneous solid dispersion results. Again, melting point, tensile strength and hardness are increased. Such a modified paraffin wax, when used in paper coatings, exhibits substantial reduction in blocking tendency and increased resistance to water and water vapor.—**Phillips Petroleum Co., Bartlesville, Okla.** **152C**

(More Product News on p. 154)

CSC makes more METHANOL

With the recent opening of the valves of the newly completed $20 million facilities at Sterlington, Louisiana, Commercial Solvents Corporation becomes one of the world's largest producers of methanol, for sale to meet the growing needs of expanding American Industry.

For steady, dependable large-volume supply of methanol, CSC is your logical source.

High-quality CSC methanol, produced from natural gas, is being supplied at a minimum purity of 99.85% in tanker, barge, tank car, tank truck and drums to all parts of the United States from conveniently located bulk and distribution points. For further information contact the Industrial Chemicals Div., Commercial Solvents Corporation, 260 Madison Ave., New York, N. Y.

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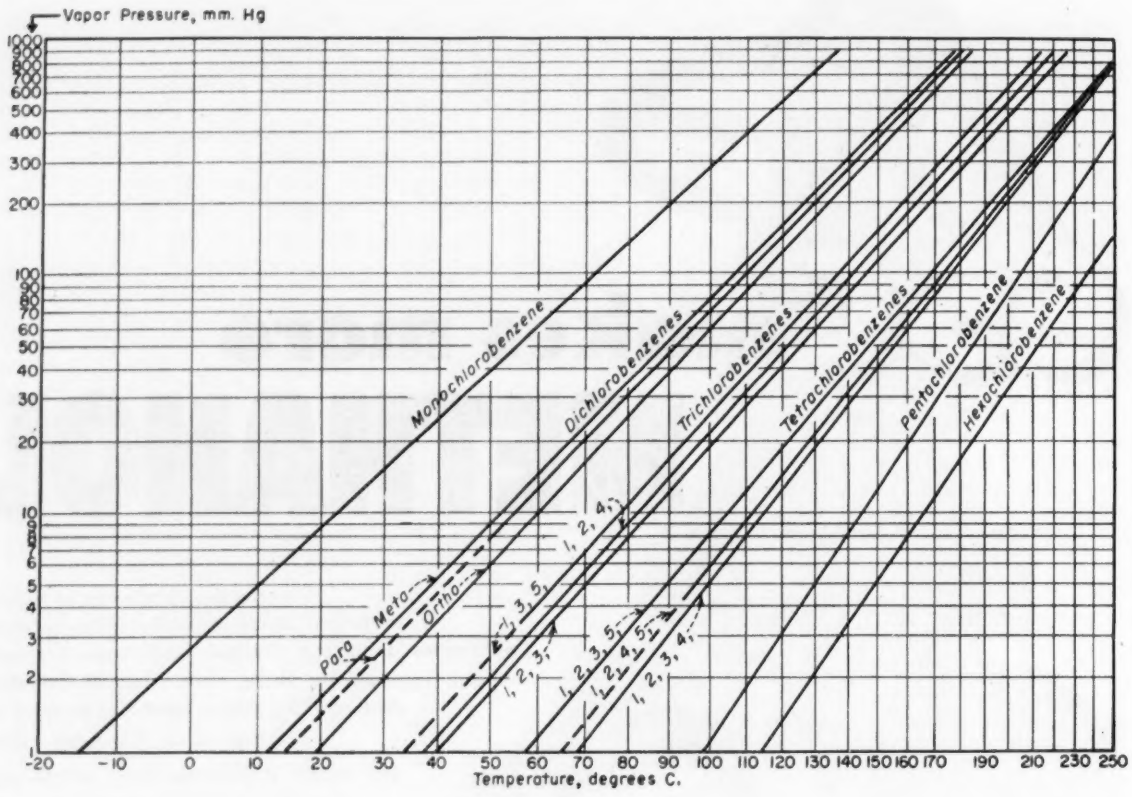

New Data on Pure Chlorobenzene Isomers

Had you attended a meeting of the French Academy of Sciences on the fifth of February in 1849 you would have heard Laurent and Gerhardt describe their synthesis of monochlorobenzene from phenol and phosphorus pentachloride.

This news sparked many other chemists into studying the preparation, properties and reactions of the chlorobenzenes. They found that physical, chemical and biological properties depend on the arrangement of chlorine atoms on the benzene ring. Much time and effort were expended in directing the chlorination reaction and separating the products.

During the past several years Allied Chemical & Dye's Solvay Process Div. has been actively studying aromatic chlorination reactions. They have prepared most of the possible products of substitution chlorination of benzene, stressing precise separation of the pure isomers. Many careful measurements of physical properties have yielded vapor pressure curves (above), infra red spectograms and other valuable data.

In August 1952 Solvay announced the availability of sample quantities of 99+ percent-pure orthodichlorobenzene. Until that time, ortho had been available in drum and tank car lots, but only as a relatively impure product containing as much as 15 percent para isomer.

Pure ortho found use as a pure, relatively high-boiling solvent in the synthesis of dyes, pigments and in other reactions where its constant quality specifications are required to insure dependable results from batch to batch.

Early last year Solvay introduced pure grades of 1,2,3- and 1,2,4-trichlorobenzene (see *Chem. Eng.*, April 1953, p. 263). Like the pure ortho, these products are ideal when purity of solvent or reactant is important for constant product specifications. Examples are in the synthesis of dyes and herbicides and in the production of many organic intermediates.

Now two new additions join the growing group of high purity chlorinated aromatic chemicals being studied by Solvay: 1,2,3,4- and 1,2,4,5,-tetrachlorobenzene. They are available in experimental quantity to researchers wishing to evaluate the reactions of pure isomers. (*Continued*)

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

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Derivatives of 1,2,4,5-tetrachlorobenzene have shown biological activity in several fields. Its phenol, 2,4,5-trichlorophenol, reacts with chloracetic acid to produce the important plant hormone, 2,4,5-T, which is active in the control of a wide variety of woody plants, shrubs and vines. Two molecules of 2,4,5-trichlorophenol can be condensed with one of formaldehyde to produce a patented, very active bactericide used in germacidal preparations for both personal and hospital use.

The 1,2,3,4,- isomer has found application in heat exchange fluids for electrical transformers. Big advantage here is a high chlorine-to-hydrogen ratio which offers protection against fire and explosions.

All of Solvay's chlorobenzenes are produced at the company's Syracuse, N. Y., plant. Commercial quantities of mono, ortho and para isomers are made, plus pilot plant quantities—small drum lots—of the pure isomers discussed above. In addition, the company is now making four other pure isomers on a bench scale. These are: 1,3,5-trichlorobenzene, 1,2,3,5,-tetrachlorobenzene, pentachlorobenzene and hexachlorobenzene. **154A**

Plasticizing Polyol

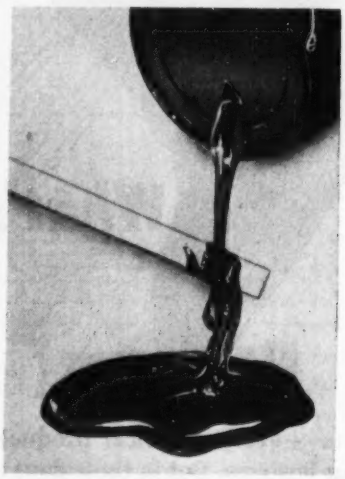
Maintains texture in glues, paper products and tobacco.

Atlas G-2401, an 85 percent aqueous solution of technical hydroxypropyl sorbitol, has hygroscopic, viscosity and noncrystallizing properties that make it extremely useful as a plasticizer and conditioner. It is less hygroscopic than glycerol, retains appreciable viscosity while holding relatively large amounts of water and does not crystallize under normal operating conditions. And because of its narrow humectant range, gains or losses of moisture with changing humidity are slower than with glycols and glycerol.

These properties suggest uses as a softener in glue specialties, including vegetable adhesives, gelatin for photographic films and grease-proofing compositions. Sales as a conditioner for cellulose and paper products, shoe dressings, tobacco and pastes are also expected.

Compared to glycerol as a glue plasticizer, hydroxypropyl sorbitol is reported to give higher viscosities at equal water content, less tacky films and higher tensile strengths. Setting temperatures are about equal, and although the product gives slightly lower gel strength at 25 deg. C., gel strength at 40 deg. C. is higher than with glycerol.

Price is low, compared to other noncrystallizing polyols, and 1-, 5- and 55-gal. containers are available.—**Atlas Powder Co., Wilmington 99, Del.** **156B**

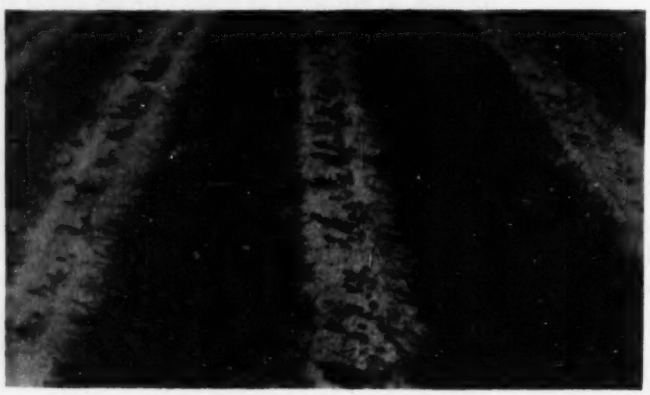


Flowable Rubber

For use in adhesives, conductive rubber and as a plasticizer.

The first free-flowing synthetic rubber, a liquid copolymer of butadiene acrylonitrile (27 percent), is now on the market. Called DPR Synthetic N-27, it will be used as a raw material for plasticizing or modifying plastics and synthetic resins.

Being entirely synthetic, the product is subject to wider modifications than natural rubber. Thus it can be used effectively in conductive rubber, adhesives and as a plasticizer for crude and synthetic rubber. It is used to rubberize resins, to which it imparts rubber-like characteristics.—**DPR, Inc., Belleville, N. J.** **156C**



Pictorial proof of herbicide's effectiveness

Good to excellent results are reported by state testing services on CIPC—isopropyl n-(3-chlorophenyl) carbamate. Unlike other herbicides, CIPC is applied to soil before grasses start to grow, preventing them from germinating. Note thick weeds in untreated bands in comparison with clean treated rows. Major producers: Columbia-Southern, USI, Monsanto and Pittsburgh Agricultural Chemical. **156A**

Stabilizer for Organics

Lead salt is especially suited for use with halogen-containing organic materials.

A new lead compound that's described as being unusually effective in formulations subjected to high heat will probably find its biggest use as a

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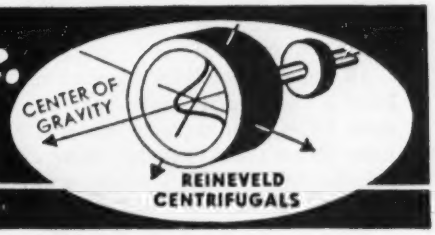

heat stabilizer in both opaque and rigid polyvinyl chloride compositions. Called Stayrite #229, it is also used for stabilizing chlorinated paraffins and as a curing agent for chlorosulfonated polythene.

All the lead oxide content of the product is available for the elimination of hydrogen chloride released during heat degradation of PVC. And its high refractive index–2.0–enables it to function both as a pigment and as a screening agent for ultraviolet light. **–Witco Chemical Co., New York 16, N. Y.** **156D**

Acids from Redwood

Low cost, weak organic acids are now being made from tree bark.

Latest utilization of "waste materials" is a new line of redwood bark extracts now being test marketed by Pacific Lumber Co. The products are palcotanic acid, palconic acid and the sodium salt of each, and the company's semi-works plant at Scotia, Calif., culminates over 15 years of research. Carload quantities are available.

To make the compounds, bark is first fed to a chipper, then extracted under pressure with either neutral sodium sulfite or caustic soda at about 325 deg. F. for one hour. The solution and residual fibers are then sent through dewatering screws where the bark pulp is separated from the chemical extract.

With sulfite as the pulping agent, direct vacuum drying produces the sodium salt of palcotanic acid, a complex of weak, sulfonated organic acids. This salt has been tradenamed Palcotan. When the sulfite extract is acidified with mineral acid before drying, the finished product is palcotanic acid itself.

If caustic is the pulping agent, the end products are Palconate, the sodium salt of palconic acid, a complex of weak unsulfonated organic acids, and palconic acid.

All four compounds are inexpensive, lower in carbohydrate content and far more active then organics recovered from conventional pulping liquors. Palcotan, in particular, is soluble over the entire pH range.

Applications include use as dispersing agents in gypsum board, linoleum paste and carbon black (in masterbatching with latex rubber); binders and deflocculants in ceramic clays; anti-oxidants and sequestering agents in boiler feed water; partial phenol replacement in plywood adhesives and molding compounds; floatation agents in ore beneficiation.

Palconate has also been used as a stabilizer in asphalt emulsions and shows promise in its ability to form insoluble salts with many metals. To date, however, the largest sales have gone to the oil fields as a replacement for quebracho in drilling muds.– **Pacific Lumber Co., San Francisco, Calif.** **158C**

New Plasticizers Make Better PVC

Atlas Powder's Pycal 170, when combined with DOP, outperforms other auxiliary low-temperature plasticizers for PVC.

Monsanto's DIDP, a general purpose, low volatility plasticizer for PVC, is priced to compete with dioctyl phthalate.

Combinations of this new, aromatic acid based product and di-2-ethylhexyl phthalate (DOP) are being used to plasticize polyvinyl chloride. Advantages claimed are: better low temperature properties than DOP alone; low volatile loss; lower soap extraction loss; less tendency to mar varnish and lacquer surfaces; lower cost than other low temperature, auxiliary plasticizers.

Because of its lower solvency for PVC resins, initial viscosities are lower and viscosity buildup is less than with straight primary plasticizers in plastisols and organisols. Recommended percentages of Pycol 170 are 10-30 percent of the total plasticizer content.**–Atlas Powder Co., Wilmington, Del.** **158A**

Di-isodecyl phthalate (DIDP), a clear oily liquid, is similar to DOP but is less than half as volatile. Tests show that after a six day heat-aging period, 22 percent of the DOP is lost, as compared to only 4.7 percent of the DIDP.

Processing techniques for the new product are similar to those for DOP, except that slightly higher calendering, extruding and dry blending temperatures may be required. It's important to note that while the original low temperature flexibility of DIDP-plasticized sheet is slightly inferior to that made with DOP, the sheets have superior flexibility two days after going through the SPI extended volatility test.**–Monsanto Chemical Co., St. Louis, Mo.** **158B**

Polyester Resins

One is self-extinguishing. Two others are for use in low-temperature curing applications.

American Cyanamid has just come out with three new and improved polyester resins. All are available in commercial quantities.

• Laminac 4110 is a low viscosity type resin designed primarily for low temperature curing applications. It is not affected by air exposure and dries to a completely tack-free surface. Surfaces can be sanded or finished immediately after cure. 4110 is recommended where good surface cure and water resistance are required in the end product.

• Laminac 4111 is a low viscosity styrene monomer modified polyester resin that can be promoted and catalyzed for low temperature or atmospheric curing conditions. It provides far greater chemical resistance than any other similar resin now on the market and fibrous glass laminates made with it retain high strength when exposed to boiling water, boiling 10 percent mineral acids and even boiling 10 percent caustic.

• Laminac 4147 permits for the first time the fabrication of translucent panels having both light stability and self-extinguishing properties. Other light stabilized panels made of polyesters continue to burn after flame is removed, but not 4147. And this property is maintained even after long exposure at 150 deg. F. Other

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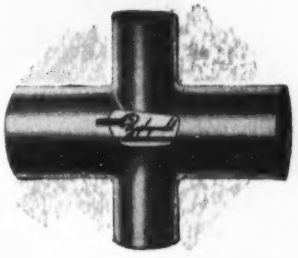
ZEPHYRWELD® WELDING FITTINGS

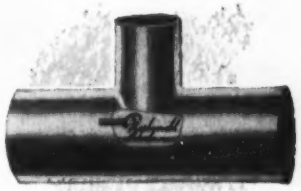
• TRI-CLOVER offers the most complete line of *Zephyrweld* Schedule 5 and 10 stainless steel welding fittings in sizes from ½" through 24" and 36" for use with stainless steel light gauge pipe. In addition, Schedule 40 fittings are available in sizes through 24".



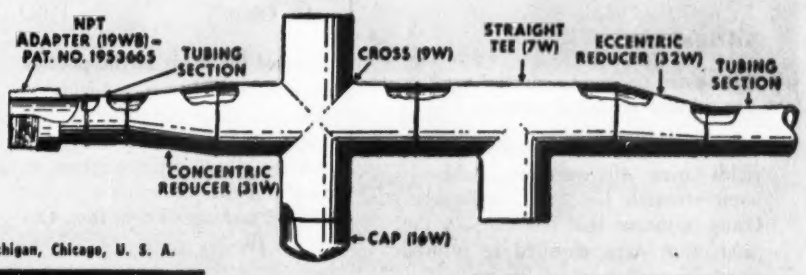
These porosity-free fittings are fabricated from stainless steel types 304, 347, 316 and other stainless steel analyses . . and are annealed, pickled and passivated in sizes through 4". Larger sizes are passivated and may be annealed upon request.

Schedule 5 and 10 fitting ends are cut flush for rapid welding. Because of their light gauge, no chamfering is required. Schedule 40 fittings are beveled in accordance with ASA specifications.

In addition to butt welding pipe fittings, Tri-Clover manufactures a complete line of stainless steel tube O.D. butt welding fittings for use with light gauge tubing.



• Shown at the right is a composite drawing showing the way in which Zephyrweld fittings are assembled, by butt welding, to light gauge pipe, or to one another. All ends are square and true—no chamfering is required to accomplish fast, clean welding. Note how Zephyrweld fittings are adapted to iron pipe size fittings through use of a special adapter.



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methods of achieving self-extinguishing properties, such as addition of a chlorine compound and antimony oxide, usually cause panels to discolor rapidly.–**American Cyanamid Co., New York 20, N. Y.** **158D**

Strippable Coating

Exhibits no oil exudation up to temperatures of 160 deg. F.

Cellulose acetate butyrate is the base plastic for a new, hot-melt, strippable coating for metals. The product, which is called Dip-Pak #661, is unique in that it does not bleed oil even at temperatures as high as 160 deg. F. and is flexible from −50 to 160 deg. F.

A fairly tough, rubbery, thermoplastic compound, it functions as a semipermanent coating for metal objects, as a strippable coating for metal, as an insulating and potting compound for objects kept below 160 deg. F. and as a plating stop-off. It is transparent, clear and extremely resistant to darkening under heat.–**Fidelity Chemical Products Corp., 470-474 Frelinghuysen Ave., Newark, N. J.** **160A**

Adhesive

Bonds copper to plastics used in printed electrical circuits.

A new copper-plastic adhesive that yields over 400 percent increased bond strength has been announced. Using it means that you can cut the production steps required in printed circuit manufacture by 75 percent.

The bond strengths obtained on copper-to-thermosetting sheets range up to 35 psi.—current specifications accept as little as 6 psi. This development may well encourage wider use of printed circuits for radio and electronic components.

Tradenamed R & A Plymaster, the new adhesive is supplied precoated on Anaconda electrolytic sheet copper. Because it's available in this form, the steps in the production of base copper-clad-laminate for printed circuits can be decreased from eight to two operations.

Two basic formulations are available. Type N is used for bonding copper sheet to a phenolic resin base. Type E is used with epoxy or silicone base laminates.–**Rubber & Asbestos Corp., Bloomfield, N. J.** **160B**

Oxidizing Agent

New source of HOCl gives nearly stoichimetric oxygen transfer.

Clorpactin, a highly buffered derivative of hypochlorous acid and an organic radical, has been attracing considerable attention as a germacide and disinfectant. Now it looks like it may have some potential as an oxidizing and chlorinating agent in the chemical process industries. Among the more important chemical uses envisaged for the product are textile stripping and bleaching, cleaning of slime from cooling towers, chlorination of rubber, oxidation of paraffin waxes to aldehydes and acids and oxidation of higher alcohols to their aldehydes.

Although its price–50¢/lb. in large quantities–is considerably above that of *CaOCl* and *NaOCl*, the fact that it effects rapid, nearly quantitative transfer of oxygen may make it competitive. Another point in its favor is that it's available in 30 grades of varying strength, thus making it possible for you to pick your own reaction rates.

In commercial production for only a year, this year's plans call for manufacture of more than one million pounds–all grades.

The nearly neutral compound–6.5-6.9 *pH*—is described as the most powerful, nontoxic germacide ever developed. Present uses range from fungicidal action against athlete's foot to deodorizing. And early test results indicate that it may prove really effective against most major disease-causing bacteria–**Guardian Chemical Corp., Long Island City, N. Y.** **160C**

Product Briefs

A new grade of vinyl resin, tradenamed Pliovic DB80V, is said to have exceptionally good dry blending properties because of its particle size and shape. This makes possible a free-flowing, dry mix without using high heat or lengthy milling cycles.–**Goodyear Tire & Rubber Co., Akron 16, Ohio.** **160D**

An improved finish for acrylic plastics, Logoquant SF252, is available in pigmented colors and metallics, and unpigmented gold and aluminum metallics. It is entirely grease resistant and can be applied to first or second surfaces.–**Logo, Inc., Chicago 33, Ill.** **160G**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

PR-165, a new resin designed to improve wet strength, folding endurance and scuff resistance of paper stock, can be used for any type of pulp, including bleached rags and ground-wood stocks. It cures very rapidly.–**The Borden Co., Chemical Div., New York 17, N. Y.** **160F**

Octamethylpyrophosphoramide (OMPA Schradan) is a systemic insecticide that can be used to control aphids and mites on cotton, leaving the plant free of harmful residues. It does not harm beneficial insects–**Monsanto Chemical Co., Organic Chem. Div., St. Louis, Mo.** **160E**

Syntex L-852 is an unusual latex adhesive that's pressure sensitive to a like adhesive film, but not to uncoated surfaces, for up to a month. The water base product can be brushed or sprayed on porous or semiporous materials.–**Flintkote Co., New York 20, N. Y.** **160H**

4 GOOD REASONS
for specifying Watson-Stillman Forged Steel Fittings

Here's why **W-S FORGED STEEL FITTINGS** mean safe, dependable operation of your piping system:

1. They're *drop-forged* to produce the well-known forged fiber structure with exceptionally high tensile and impact strength.

2. They're "Safety-Factor" designed with heavy walls where you need them. Extra long bands extend well beyond the last thread.

3. They're precision machined. Special automatic angle indexing machines maintain precise angular accuracy for perfect alignment. Long accurate threads insure tight joints.

4. They're fully inspected. Gauges double-check the close tolerances, angularity, threads and sockets and concentricity.

WATSON-STILLMAN FORGED STEEL FITTINGS give you maximum resistance to pressure, temperature, corrosion, shock and vibration. They protect your system against costly shut-downs.

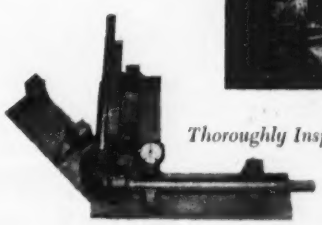
A complete line of forged fittings available in both SCREW-END and SOCKET-WELDING types in carbon, stainless and alloy steels. Write today for information.

Sold Through Leading Distributors

Drop Forged for Strength

"Safety-Factor" Design

Precision Machined



Thoroughly Inspected

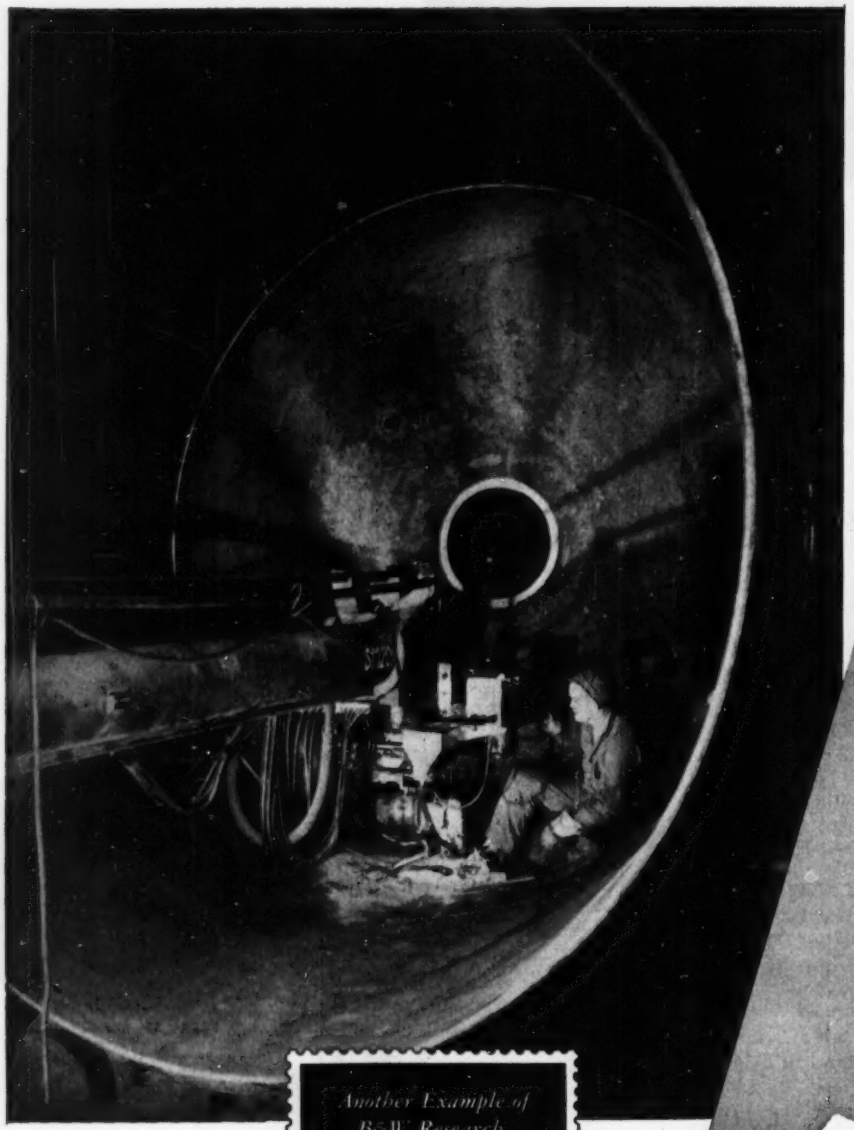
WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

this Plus Value

in B&W process equipment



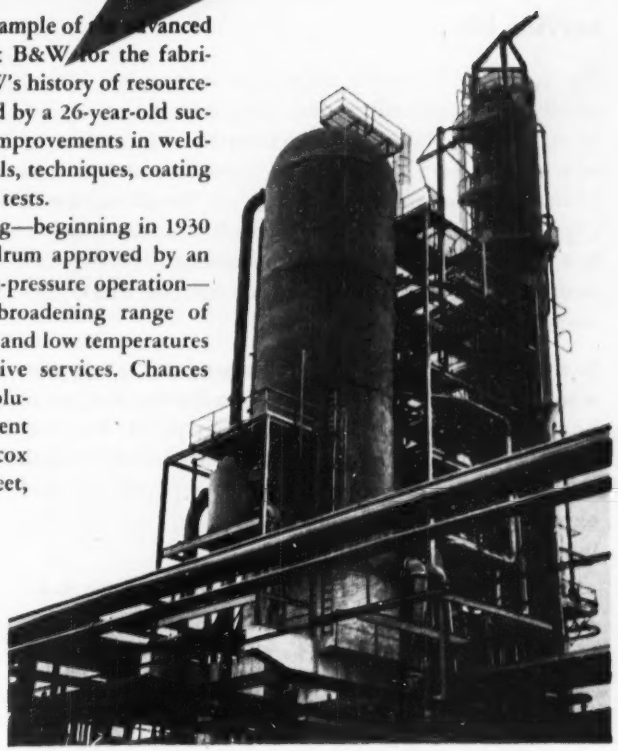
Another Example of B&W Research, Engineering & Facilities

S-4091

PAYS DIVIDENDS HERE

Illustrated at left is a typical example of [illegible]vanced welding practices employed at B&W for the fabrication of pressure vessels. B&W's history of resourceful engineering is distinguished by a 26-year-old succession of developments and improvements in welding machines, automatic controls, techniques, coating of electrodes, inspections, and tests.

B&W's leadership in welding—beginning in 1930 with the first welded boiler drum approved by an engineering authority for high-pressure operation—is being applied to an ever-broadening range of quality-welded vessels for high and low temperatures and pressures, and for corrosive services. Chances are B&W has the economical solution to your process equipment problems. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.



BABCOCK & WILCOX

Carpenter **Stainless Tubing...**

doesn't cost ...IT PAYS

... in cost-cutting corrosion resistance, time-saving fabrication, and extended service life.

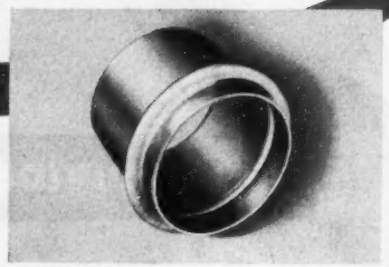
It's this way. There's a difference in stainless tubing quality and uniformity—and Carpenter makes it. Pictured here are three random examples. Hundreds more are on file from process equipment fabricators and chemical plant engineers citing how the difference in Carpenter Stainless Tubing pays off in easier fabrication, lower production and maintenance costs, and more freedom from costly corrosion troubles and equipment "down-time".

In short, you get all-around stainless tubing satisfaction when you give Carpenter Stainless Tubing the job of handling corrosive materials in your plant. You can count on your nearby Carpenter Distributor or Branch Office for prompt service on your requirements and experienced technical help in selecting and fabricating your tubing.

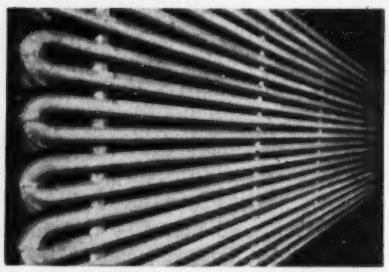
The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Branch Offices: Atlanta Chicago Pittsburgh Houston Newark San Francisco

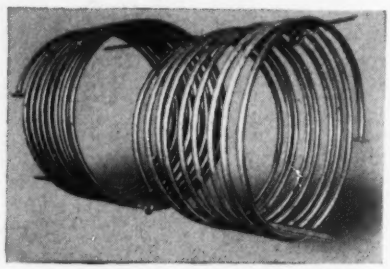
Export Dept.: The Carpenter Steel Co., Port Washington, N. Y. "CARSTEELCO"



FOR EQUIPMENT PARTS—ability of Carpenter Stainless Tubing to "take" severe fabrication due to its uniformity and ductility saved fabricator of this bubble cap 10c a piece and enabled him to get longer production runs.



FOR PROCESSING EQUIPMENT—ten cooling coils like this were made from Carpenter Stainless Tubing at a saving in material of about $1000 because uniform walls permitted using a lighter gauge.



FOR SUPER CORROSION RESISTANCE—coil life in a hydrolysis tank was more than doubled by switching from lead to Carpenter Stainless No. 20.

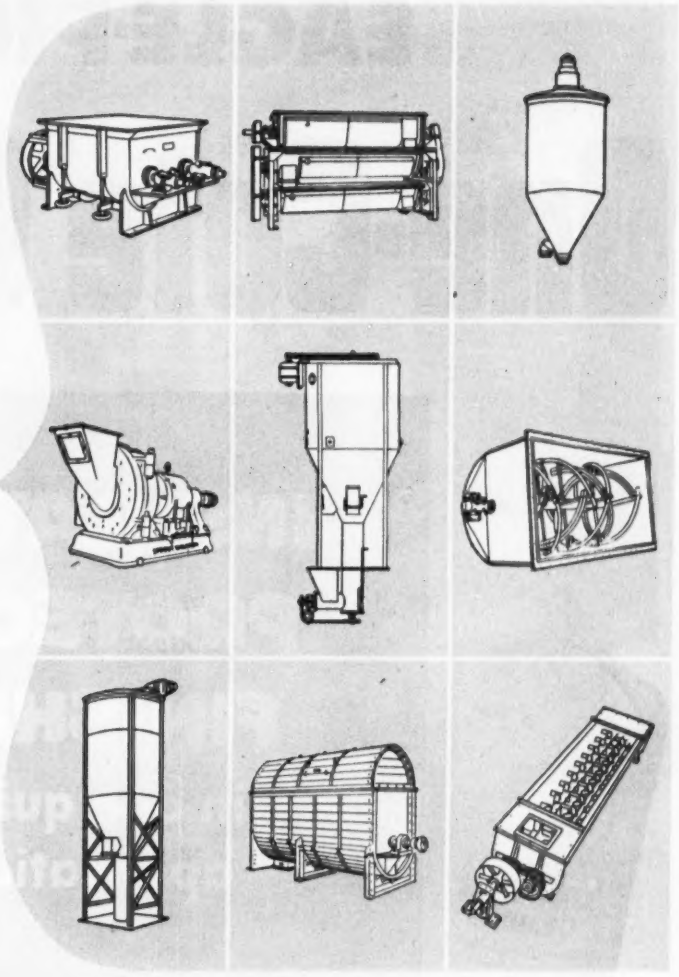
Carpenter

STAINLESS TUBING & PIPE

Analysis → Tolerance → Finish →

• guaranteed on every shipment

what's most important to you in **MIXERS**?



FLOOR SPACE?
If limited space is your problem, Sprout-Waldron may have the answer. We have mixers so compact that one with 1250 cu. ft. capacity occupies only 90 sq. ft. of floor space.

POWER?
You can save power with Sprout-Waldron mixers—verticals in sizes up to 1500 cu. ft. operate with as little as 30 h. p.

CORROSION RESISTANCE—MATERIALS CONTAMINATION?
You can get a Sprout-Waldron made of wood, stainless steel, black iron, non-ferrous or commercial alloys engineered to meet your specific needs.

SELF-CLEANING?
Sprout-Waldron verticals are naturally self-cleaning, and horizontals can be made nearly so.

MIXING TIME?
Certain Sprout-Waldron models produce complete mixes in seconds after being charged with the last ingredient.

EASE OF CHARGING?
Some Sprout-Waldron mixers are self-contained—equipped with their own loading or charging means.

DISCHARGE EFFICIENCY?
Sprout-Waldron mixers can dump entire charge in one mass with properly designed discharge gates.

INTIMATE BLENDING?
With a Sprout-Waldron blender, particles can be made to lose their individual identities.

DUST AND PRESSURE TIGHTNESS?
All Sprout-Waldron models can be made dust-tight and pressure-tight.

TEMPERATURE CONTROL?
At Sprout-Waldron there is the know-how to incorporate heating, cooling and drying with mixing.

VISCOSITY PROVISIONS?
Sprout-Waldron equipment mixes dry and semi-dry materials, adds liquids to solids, and even mixes molasses in January.

Whatever your mixing requirements, Sprout-Waldron meets them with dependable guidance, unique *"adaptioneering"* methods, a complete line of equipment, and top-notch service. You get more at Sprout-Waldron, because Sprout-Waldron has more to give. Let us advise you on your next mixer installation without cost or obligation. *Please write for details.*

YOUR INVESTMENT PROTECTED
Our 88 years of service to industry is good assurance that you can obtain parts and service for the life of your Sprout-Waldron equipment.

SPROUT-WALDRON
Manufacturing Engineers Since 1866
Equipment for SIZE REDUCTION • MIXING & BLENDING • BULK MATERIALS HANDLING • PELLETING & CUBING • PRODUCT CLASSIFICATION
Facilities for fabricating, machining, custom founding, woodworking, laboratory testing
15 LOGAN STREET • MUNCY, PA.

325

EAGLE-PICHER

One-Cote Cement

INSULATES PROTECTS FINISHES

in one quick application

ONE APPLICATION saves valuable man-hours! Whether equipment is hot or cold (above 32 F), your crew simply trowels on the white, clean-handling cement to get a smooth, light-reflectent insulating surface.

ONE APPLICATION assures high thermal efficiency at temperatures up to 1000 F. One-Cote Cement sets quickly—and when installed indoors requires no finishing treatment. In outdoor installation, a weather-protective coating is recommended.

For a cement that INSULATES—PROTECTS—FINISHES in one application, you owe yourself a thorough investigation of Eagle-Picher One-Cote. For example, one of the many plus advantages you will value is its rust-inhibitive quality—it actually protects your valuable equipment. Get *all* the facts, today!

RECOMMENDED APPLICATIONS *Valves and fittings • storage tanks • digesters • breechings • glass and ceramic kilns • stills • ovens • steam cylinders • air preheaters • hot air ducts • turbines • piping*

Since 1843

EAGLE EP PICHER

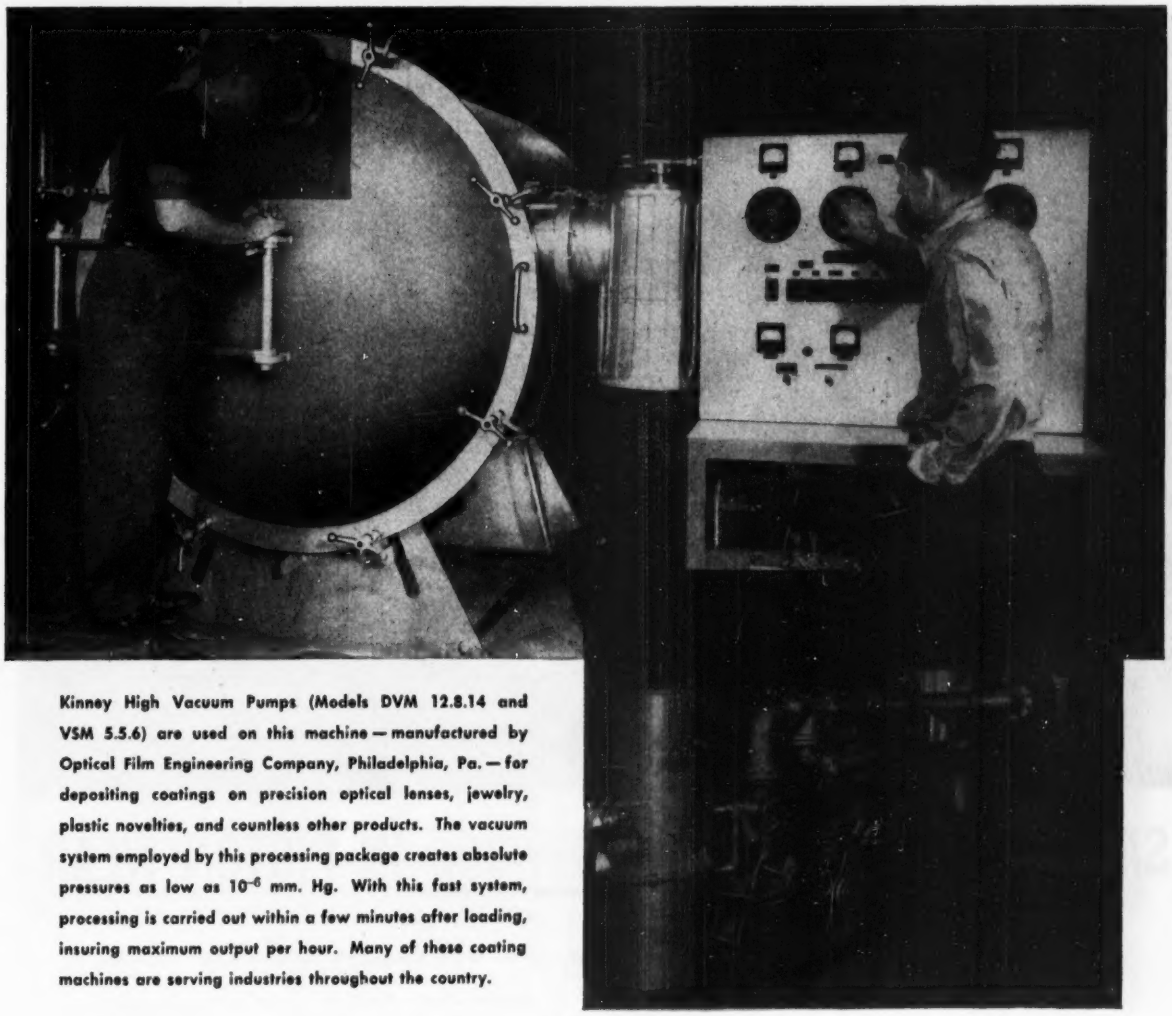
THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

For greater efficiency, protection and economy, specify these Eagle-Picher products:

Insulating Felts • Insulating Block • Blankets • Loose Wool • Mineral Wool Pipe Covering • Stalastic Stamastic • Insulseal • Finishing Cements • Insulating Cements • Swetchek • Insul-Stic • Fireproofing Cement

Member of Industrial Mineral Fiber Institute



Kinney High Vacuum Pumps (Models DVM 12.8.14 and VSM 5.5.6) are used on this machine — manufactured by Optical Film Engineering Company, Philadelphia, Pa. — for depositing coatings on precision optical lenses, jewelry, plastic novelties, and countless other products. The vacuum system employed by this processing package creates absolute pressures as low as 10^{-6} mm. Hg. With this fast system, processing is carried out within a few minutes after loading, insuring maximum output per hour. Many of these coating machines are serving industries throughout the country.

How to get the right vacuum pump

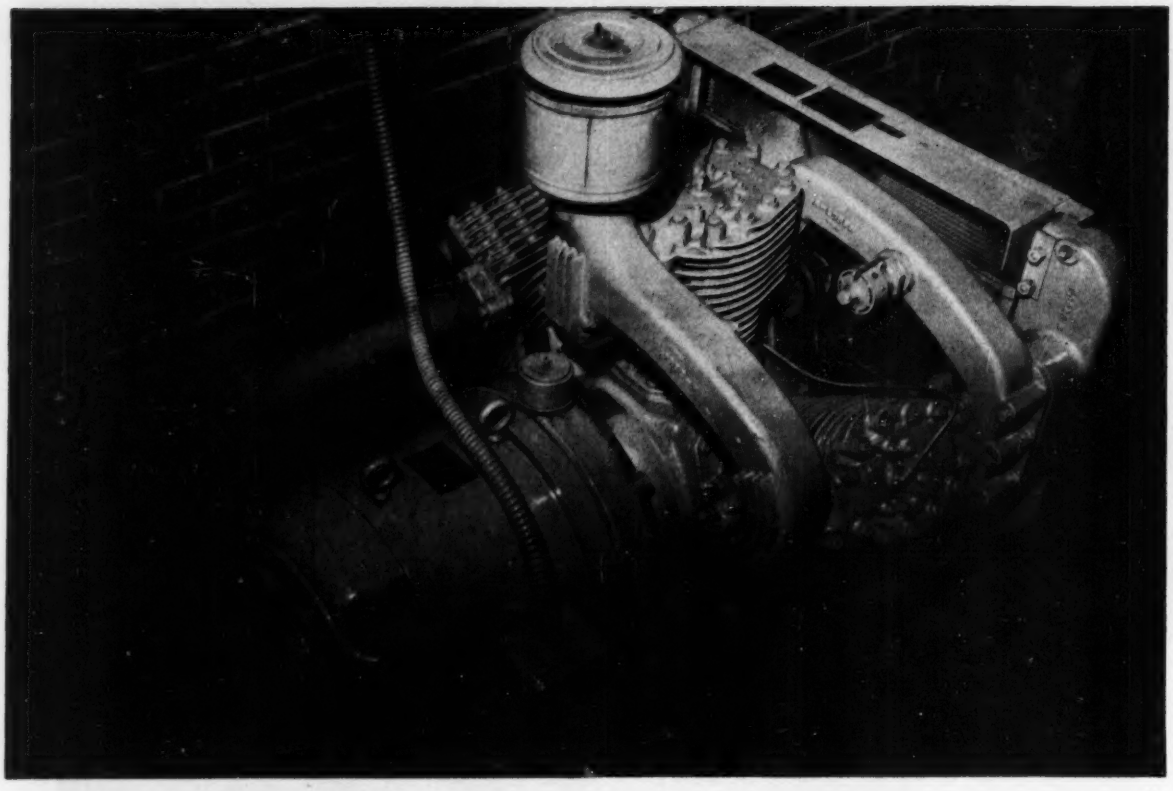
By consulting Kinney, you can choose from our line of 13 Single Stage and Compound vacuum pump models . . . the biggest, most versatile pump line on the market. We can help you size and apply these reliable high vacuum pumps to your vacuum processing operations. Our district offices are staffed with competent vacuum engineers, to assist you.

SEND COUPON TODAY!

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.

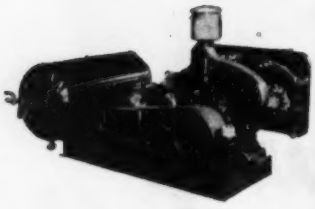
☐ Please send Bulletin V-51B describing the complete line of Kinney Vacuum Pumps.

Name.....
Company.....
Address.....
City..... State.....



SAVE ALMOST A MILE EVERY HOUR* IN PISTON WEAR WITH A JOY WL-80 COMPRESSOR—

** Piston speed is lower than that of four comparable compressors. So low that you save over 6½ miles of wear each 8-hour day.*



Joy WL-80 "Packaged Unit" Compressor can be delivered ready-to go, complete with air receivers, piping and wiring.

NEED A SMALL, COMPACT COMPRESSOR as an auxiliary air supply? Or possibly you want a compressor that can be placed right where the air is used and eliminate long runs of piping.

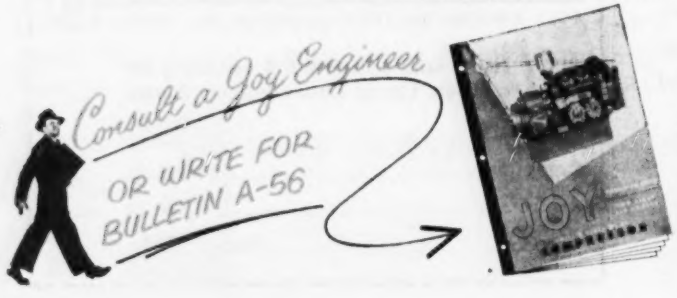
If your requirements call for 640 CFM or less, there's a Joy WL-80 for you:

- *15 to 125 HP.*
- *81 to 641 CFM.*
- *Pressures to 125 psi, standard. (High pressure units to 250 psi).*
- *Single or two stage.*
- *Air cooled.*
- *Force-feed lubrication.*
- *Eleven models.*

. . . And, you have your choice of drives: Direct, V-Belt, Flange-Mounted. In fact, these compressors are available as packaged units, like that shown at the left, delivered complete with air receivers, piping and wiring.

* * *

Get full details by writing for Bulletin A-56. ● **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



WAD 4942

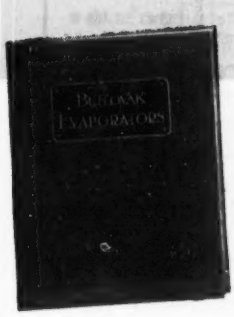
JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

An example of BUFLOVAK Forced Circulation and V.R.C. (Vertical Rapid Concentration) Evaporator. This one is used for concentrating a citrus by-product.

An example of BUFLOVAK Natural Circulation Type Evaporator. This is a Quadruple Effect used to concentrate a food product. Automatically controlled.

each evaporator problem has one best answer



BUFLOVAK catalogs have a wealth of valuable information for you on drying, evaporation and processing. A request on your company letterhead will bring copies to you.

If *you* have an evaporator problem it must be treated individually . . . *if* you want the most profitable return on your invested dollars.

BUFLOVAK Vertical Rapid Concentration Evaporators provide high rates of evaporation, maximum recovery of solids, with simple, easy operation. You can pre-test in the BUFLOVAK Testing Laboratory in order to be doubly sure. Your engineers and ours do the testing, or we do it for you. Recommendations follow, based squarely on the results obtained.

BUFLOVAK V.R.C. Evaporators offer many operating advantages in concentrating liquids which do not precipitate crystals during concentration. Particularly, heat-sensitive materials, foamy liquids, and products requiring sanitary operation. Other types of BUFLOVAK Evaporators are available also, to serve every industry where liquids must be concentrated.

All BUFLOVAK equipment is designed, built, guaranteed and serviced by BUFLOVAK. Every manufacturing operation is performed in our own shops. We're ready to help you with your processing problems, regardless of the nature of the product or the result desired.

THE BUFLOVAK ANSWER

is based on lowest overall operating cost

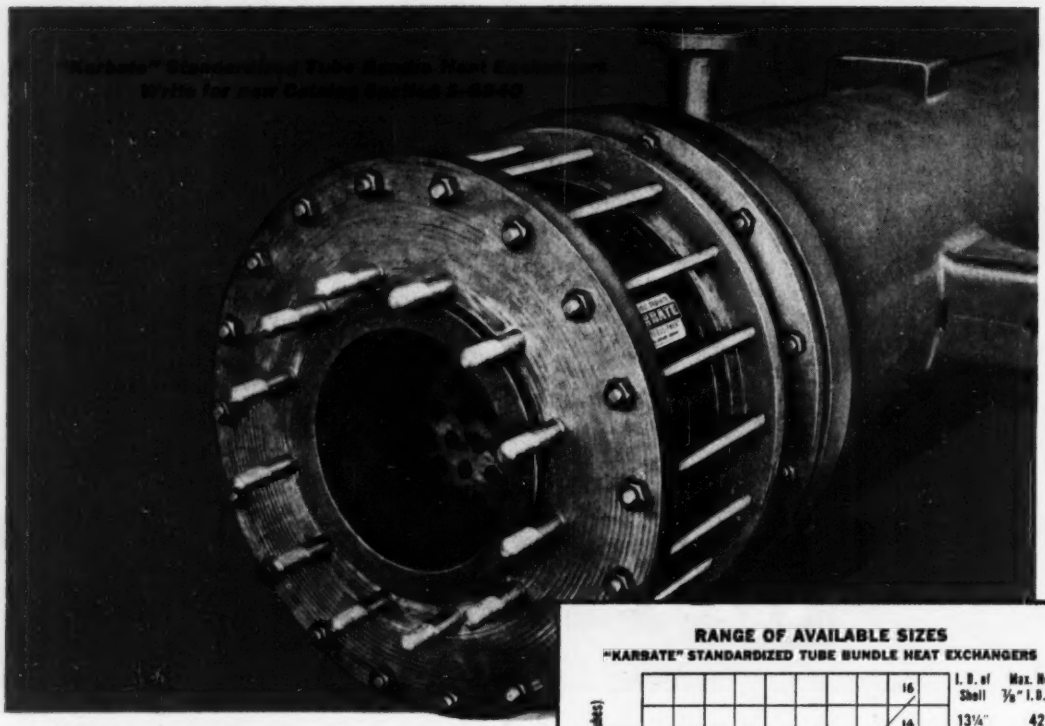
BUFLOVAK EQUIPMENT DIVISION

OF BLAW-KNOX COMPANY

1551 Fillmore Avenue, Buffalo 11, New York

BLAW-KNOX

CUT YOUR COST...



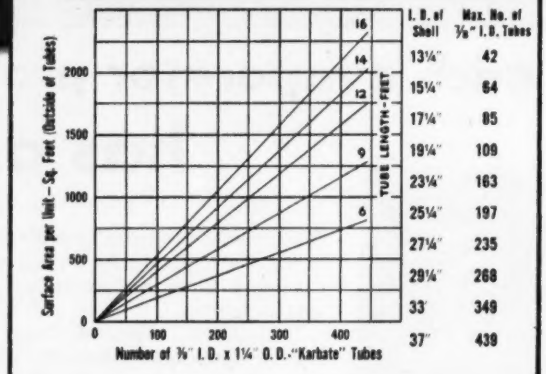
NEW STANDARDIZED HEAT-EXCHANGER DESIGN GIVES YOU:

- **LOWER FIRST COST**... through quantity production
- **MORE AREA PER UNIT**... to 2300 square feet per tube bundle
- **CHOICE OF TUBE LENGTHS**... 6, 9, 12, 14, 16 feet
- **FASTER DELIVERY**... from extensive factory stocks

...and includes these advantages of "Karbate" Impervious Graphite:

- **COMPLETE CORROSION RESISTANCE**
- **HIGH THERMAL CONDUCTIVITY**
- **IMMUNITY TO THERMAL SHOCK**

RANGE OF AVAILABLE SIZES
"KARBATE" STANDARDIZED TUBE BUNDLE HEAT EXCHANGERS

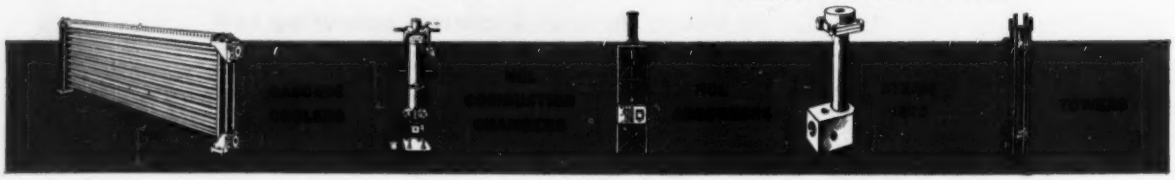


I. D. of Shell	Max. No. of ⅜" I. D. Tubes
13¼"	42
15¼"	64
17¼"	85
19¼"	109
23¼"	163
25¼"	197
27¼"	235
29¼"	268
33"	349
37"	439

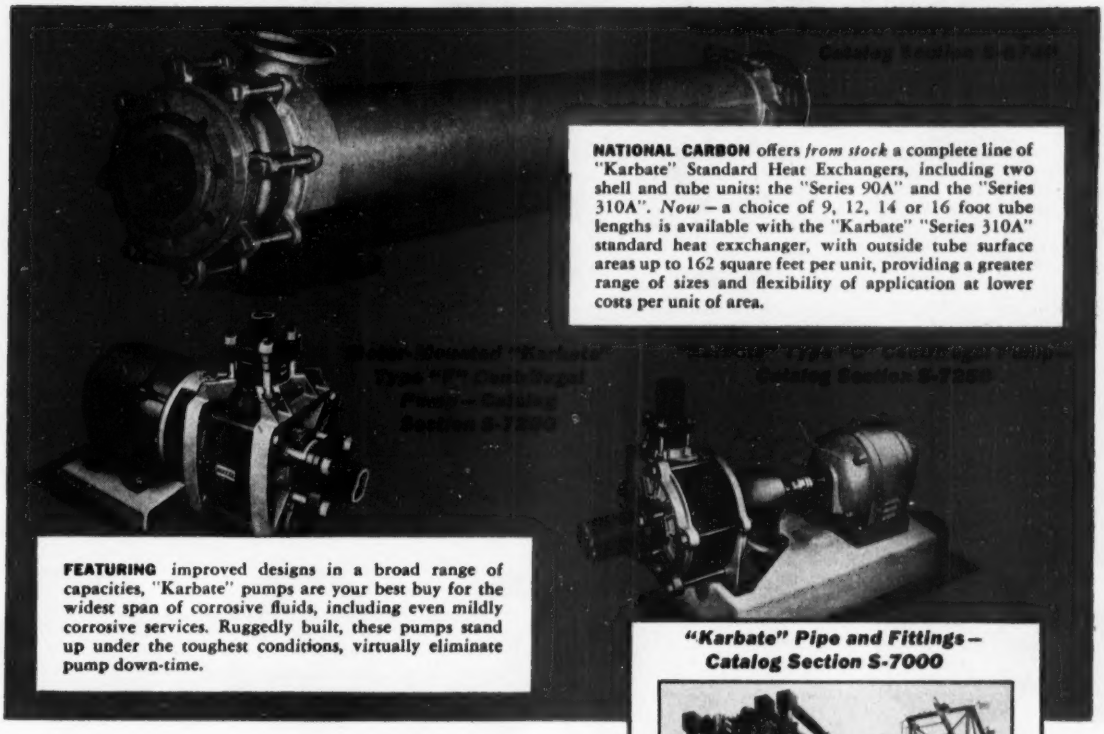
HERE'S HOW IT WORKS: "Karbate" impervious graphite standardized tube bundles and covers offer a range of tube surface area from 80-2300 square feet (see chart). In cooperation with National Carbon, leading heat exchanger manufacturers use these standard parts in units of their own design. A "one-best" standard, floating-end construction permits full use of the exchanger-manufacturers' extensive experience without shell-design limitations.

Not only in severely corrosive services, but *wherever* corrosion is a factor, "Karbate" impervious graphite equipment offers attractive savings and operating advantages. Be certain you are taking full advantage of this versatile material of construction!

WRITE FOR NEW LITERATURE!



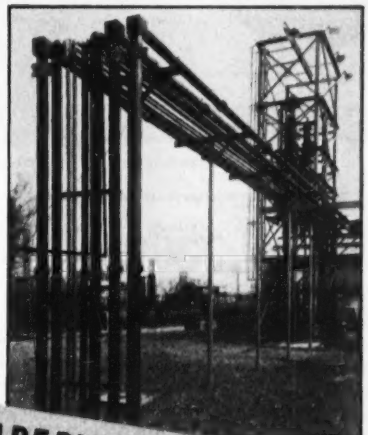
...WITH "KARBATE"
BRAND
IMPERVIOUS GRAPHITE PROCESS EQUIPMENT



NATIONAL CARBON offers *from stock* a complete line of "Karbate" Standard Heat Exchangers, including two shell and tube units: the "Series 90A" and the "Series 310A". *Now* – a choice of 9, 12, 14 or 16 foot tube lengths is available with the "Karbate" "Series 310A" standard heat exxchanger, with outside tube surface areas up to 162 square feet per unit, providing a greater range of sizes and flexibility of application at lower costs per unit of area.

FEATURING improved designs in a broad range of capacities, "Karbate" pumps are your best buy for the widest span of corrosive fluids, including even mildly corrosive services. Ruggedly built, these pumps stand up under the toughest conditions, virtually eliminate pump down-time.

"Karbate" Pipe and Fittings – Catalog Section S-7000



• You're smart to cut costs with "Karbate" impervious graphite equipment . . . smarter still when you save *all the way* – with "Karbate" pipe, valves and fittings. They're light in weight, unaffected by most chemicals, immune to thermal shock – perfect "go-betweens" in corrosive processes.

WRITE FOR NEW LITERATURE!

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

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A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N.Y.

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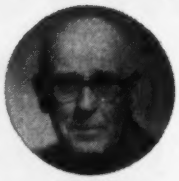
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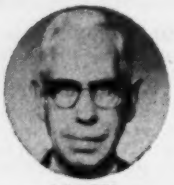
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WASHINGTON, D.C.

During the 37 years our firm has been specializing in jet vacuum equipment, we have built up an exceptional organization of engineers who devote their full time to this important equipment. We have also acquired during this period a group of engineering representatives in twenty cities who handle our equipment in their respective territories. These men are all outstanding engineers. Each has average or better engineering education and many years of experience including detailed experience on our jets and condensers. Incidentally, these jets are used for vacuum cooling, jet mixers, jet heaters, jet absorbers, fume scrubbers, thermo-compressors, etc. Please contact any of them or us when you want to take advantage of our long experience in this highly specialized field.

CROLL-REYNOLDS

Croll-Reynolds CO., INC.

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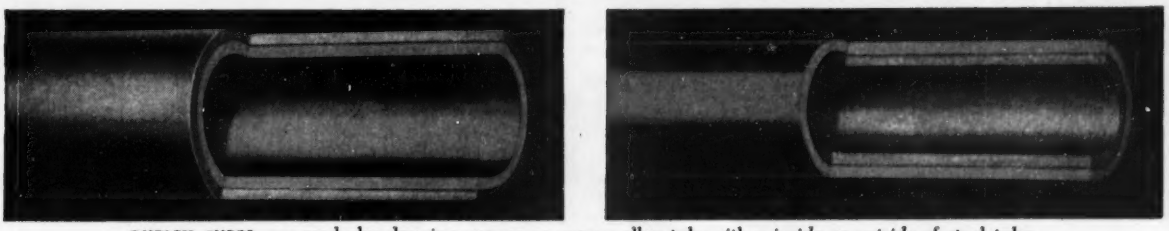
CHILL VACTORS • STEAM JET EVACTORS • CONDENSING EQUIPMENT

SAMPLE ANACONDA DUPLEX TUBE with a ferrule attached.



DUPLEX TUBES are made by drawing copper or copper alloy tube either *inside* or *outside* of steel tube.

Special purpose ANACONDA® Duplex Tubes

Can be supplied with ferrules attached

DUPLEX TUBES ARE MADE FOR MANY USES other than heat exchangers. These solved an unusual problem for Taylor Forge & Pipe Works, Gary, Ind. They needed copper tubes 6" O.D. x 4" I.D. x 24' long to carry the 12,000 amps at 12 volts required for the I.D. nickel plating of large steel pipe. The copper tube would weigh close to 1500 pounds which exceeded the weight of commercial size tube billets. However, we were able to meet our customer's requirements economically by furnishing ANACONDA Duplex Copper Tubes.

TODAY Duplex Tubes are being used more than ever to meet situations where corrosive conditions on the inside and outside of a tube are different. Other advantages: less maintenance and fewer shutdowns; better heat transfer; better resistance to treated and untreated waters.

Double-walled ANACONDA Duplex Tubes are available in a wide range of sizes, gages and alloys. They can be supplied with the external tube cut back to receive ferrules for rolling into the tube sheet—also with ferrules attached. The nonferrous tube may be drawn either inside or outside the steel tube. Duplex Tubes can also be made from two different nonferrous alloys.

Duplex Tubes may well be the answer to your dual-corrosion problem. Write to our Technical Department outlining your requirements. They'll be glad to put their experience to work for you. *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

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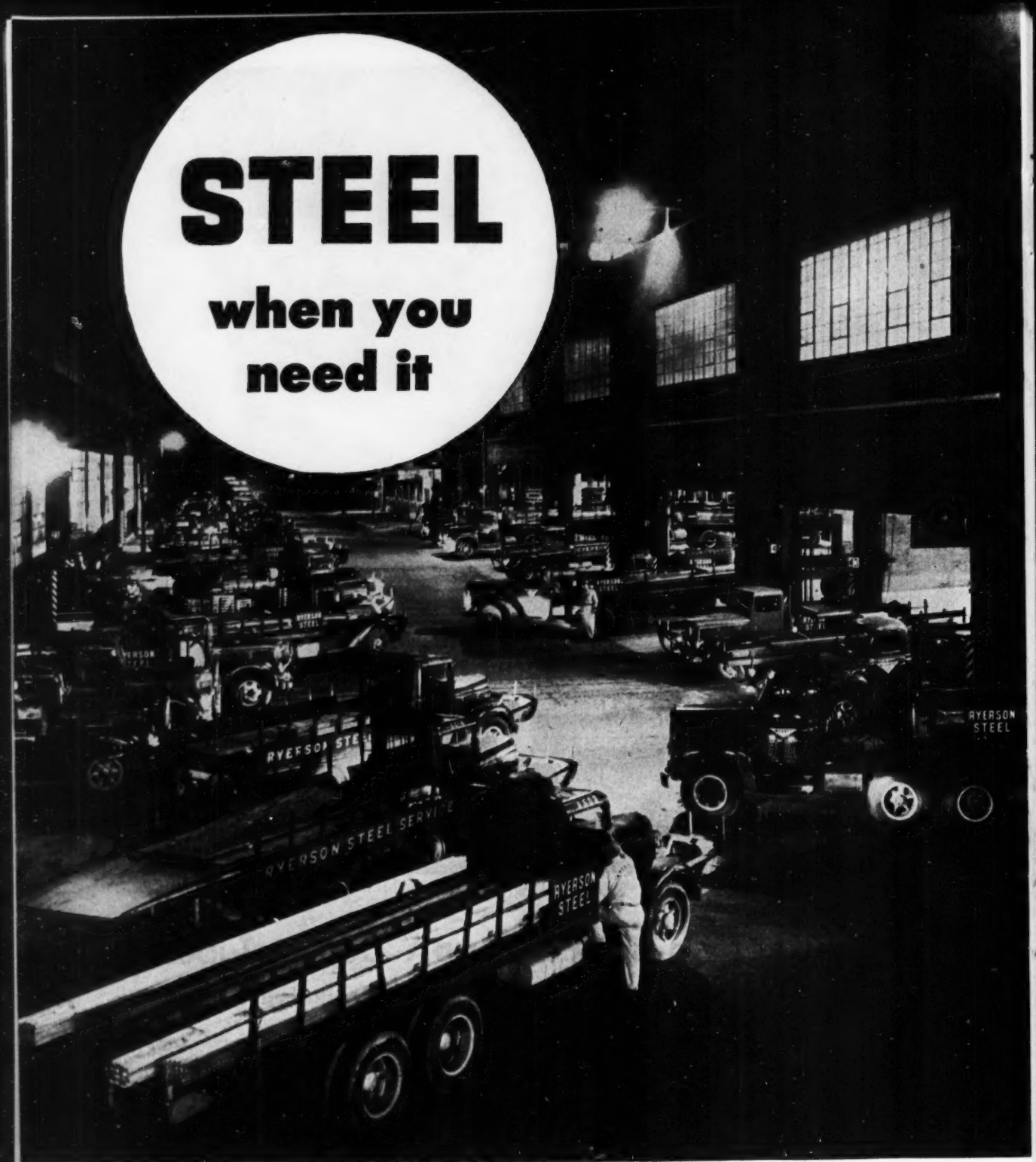

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RYERSON

Chemical Engineering APRIL 1954

Make the Most of Capital Ratios

PLANT COST = CAPITAL RATIO × ANNUAL SALES

LAWRENCE LYNN

Capital ratio is a useful tool in making exploratory cost estimates. You can use it directly to approximate plant investment when the selling price of the product is known—and vice versa—or you can use it as an order-of-magnitude check of the reasonableness of more carefully prepared estimates.

Capital ratio R is defined as the ratio of plant value C to annual sales volume S, both expressed in monetary units of the same value.

Its usefulness as an estimating tool depends upon how much information you have about actual capital ratios of going concerns engaged in operations similar to the one under consideration. Tyler[3] briefly mentions capital ratio, stating that the average chemical plant investment is about \$1 per dollar of product, with limits of about \$0.75 to \$1.25 per dollar of product.

Basis for Study

This article presents the results of a statistical study of sales volumes, total assets, fixed assets and plant values for 100 major companies engaged in chemical processing operations over the years 1939 through 1952. These figures are grouped by definite industrial categories, e.g., petroleum, glass, pharmaceutical, etc. Results are summarized in the accompanying table.

LAWRENCE LYNN *is head of Celanese Corp.'s process engineering section at the Summit (N. J.) research laboratories. He co-authored an article which appeared in* Chemical Engineering *last April on the use of nomographs for presenting the results of economic studies.*

A variety of diverse sources provided data for this study, but three in particular stand out. These are a compilation by Aries and Spence,[1] the portfolio records of F. Eberstadt and Co.'s Chemical Fund[2] and numerous stock records and pamphlets from Merrill Lynch, Pierce, Fenner and Beane.[3] In all, 100 company records were examined over the period 1939-52, and 1,157 company-year cases were compiled.

Since data were available for both fixed assets *FA* and total assets *TA* at any year for the firms considered, two independent methods of approach were used. Compilations of *TA/S* and *FA/S* were prepared and were statistically checked for randomness using a histogram with probability curve plots as a check. For tests of randomness, data were selected over the period 1945-50 to include moderately bad and good years. The values of *TA/S* and *FA/S* were thus found independent of the particular year.

Adjusted values of plant facilities for each company were computed, based on such records of plant expenditures as were available. Monetary values were corrected as required, using the *Engineering News-Record* construction cost index.

Classification by Industry

Categorization of companies by various process types was complicated in many cases because a single company belonged to more than one type. In the case of Chas. Pfizer, classification in the "pharmaceuticals and fine chemicals" group is apparent. However, in the case of a company such as Celanese, which produces industrial chemicals, synthetic fibers and plastics, categorization is more complex. Each company was considered individually and classified after an analysis of assets and sales, where possible, or according to its major known product groups where insufficient data for analysis were available.

Values of *C/TA*, *C/FA*, *TA/S* and *FA/S* were computed, and capital ratios were calculated as follows:

$$(C/TA)(TA/S) = (C/S)_{TA} = R_{TA}$$
$$(C/FA)(FA/S) = (C/S)_{FA} = R_{FA}$$

The two sets of values for R were averaged and grouped statistically after, again, checking for randomness using histogram and probability plot tests. In most cases averaging R_{TA} and R_{FA} was unnecessary, since they differed by no more than 5 percent.

After calculating standard deviations, confidence limits were established for each industry group as indicated in the table.

Using Capital Ratio in Estimates

Careful consideration of the significance of capital ratio will show that it is a very useful tool as long as its limitations are clearly kept in sight. Given a new product or process idea, you can, using this ratio, roughly approximate the cost of the plant required to produce the product if the sales value is known.

Strictly speaking, this can be done only for a completely new plant, rather than for an improvement or modification of an existing plant. If old equipment, salvage, surplus or existing facilities represent major portions of the plant, capital ratio should not be used.

Calculation of annual sales volume

Capital Ratios in the Chemical Process Industries

Type of Industry[1]	Number of Cases[2]	Capital Ratio[3]	Standard Deviation	80% Confidence Limits
Carbon black	21	3.37	0.41	0.90
Petroleum	75	2.51	0.30	0.15
Inorganics, heavy	129	2.06	0.79	0.30
Fibers, synthetic	51	1.79	0.30	0.23
Pulp and paper	69	1.55	0.34	0.18
Chemicals, general	310	1.25	0.36	0.11[4]
Explosives	20	1.20	0.17	0.37
Sulfur	20	1.12	0.14	0.30
Glass	40	0.97	0.29	0.27
Resins and plastics	61	0.77	0.29	0.19
Rubber	38	0.75	0.15	0.12
Paints, pigments and ink	55	0.70	0.31	0.21
Foodstuffs, processed	72	0.63	0.39	0.27
Pharmaceuticals and fine chemicals	138	0.53	0.15	0.07[4]
Soap and detergents	18	0.48	0.07	0.15
Beverages, distilled	40	0.22	0.07	0.07
Total and averages	1,157	1.27	—	0.10

[1] See below for companies comprising each group. [2] Company-year cases between 1939 and 1952. [3] Ratio of plant value to annual sales. [4] 90% limits.

S requires that a competitive price on the open market be known with reasonable accuracy. Intracompany sales prices or "deal" prices can complicate and confuse the use of capital ratios which, like the figures reported here, are based on total outside sales.

Slight upward or downward modifications should be made within the 80-percent confidence limits, depending on the novelty of the process or product. For a contact sulfuric acid plant or a plant to make formaldehyde from methanol R will inevitably be smaller than for a new plant such as one, for example, producing acetylene by a novel process. Schweyer[4] suggests that normal values of R should be lower for well established processes than for new processes.

One of the problems involved in the use of R values is the classification of the proposed venture into the proper industry grouping. Certainly a product such as 3-methyl-1-pentyne-ol-3 falls in with the "pharmaceuticals and fine chemicals" listing, just as clearly as cellulose acetate yarn is clearly in the "synthetic fibers" category. But a product such as chloral, a moderately large-volume organic chemical, might be expected to fall between two groups, "fine chemicals" and "general chemicals."

Capital ratio is especially useful where raw materials costs constitute the predominant portion of total production cost and where maintenance, depreciation, taxes and insurance, all of which are related to plant cost, are comparatively small. It may also serve to advantage in cases where little or no process data are available or where time is too short for even a rough flowsheet-derived estimate.

Classification of Companies Studied

CARBON BLACK
Columbian Carbon Co.
United Carbon Co.

PETROLEUM
Atlantic Refining Co.
Phillips Petroleum Co.
Shell Oil Co.
Sinclair Oil Corp.
Socony-Vacuum Oil Co.
Standard Oil Co. (Ind.)
Standard Oil Co. (N. J.)
Texas Co.

INORGANICS, HEAVY
Air Reduction Co.
Allied Chem. & Dye Corp.
American Agric. Chem.
American Pot. & Chem.
Davison Chemical Corp.
Diamond Alkali Co.
Dow Chemical Co.
E. I. du Pont de Nemours
Hooker Electrochemical
International Salt Co.
Lindsay Chemical Co.
Mathieson Chemical Corp.
National Lead Co.
Pennsylvania Salt Mfg.
Union Carbide & Carbon
U. S. Potash Co.

FIBERS, SYNTHETIC
American Viscose Corp.
Celanese Corp. of America
E. I. du Pont de Nemours
Industrial Rayon Corp.
North American Rayon

PULP and PAPER
Champion Paper & Fibre
Crown Zellerbach Corp.
Kimberly-Clark Corp.
Marathon Corp.
Rayonier Inc.
St. Regis Paper Co.
W. Va. Pulp & Power Co.

CHEMICALS, GENERAL
Allied Chem. & Dye Corp.
American Cyanamid Corp.
American Pot. & Chem. Co.
Celanese Corp. of America
Commercial Solvents Corp.
Davison Chemical Corp.
Diamond Alkali Co.
Dow Chemical Co.
E. I. du Pont de Nemours
Eastman Kodak Co.
Food Machinery & Chemical
General Aniline & Film
Hercules Powder Co.
Heyden Chemical Corp.

CHEMICALS, GEN'L (Cont.)
Internat'l Min. & Chem.
Koppers Co.
Mathieson Chemical Corp.
Merck & Co.
Minnesota Mining & Mfg.
Monsanto Chemical Co.
Pennsylvania Salt Mfg.
Pfizer, Chas., & Co.
Pittsburgh Coke & Chem.
Pittsburgh Plate Glass
Publicker Industries
Rohm and Haas Co.
Tenn. Products & Chem.
Union Carbide & Carbon
Victor Chemical Works
Virginia-Carolina Chem.

RESINS and PLASTICS
Catalin Corp. of America
Celanese Corp. of America
Dow Chemical Co.
E. I. du Pont de Nemours
Durez Plastics & Chem.
Rohm & Haas Co.

GLASS
Corning Glass Works
Libby-Owens-Ford Glass
Owens-Illinois Glass Co.
Pittsburgh Plate Glass

EXPLOSIVES
Atlas Powder Co.
Hercules Powder Co.

SULFUR
Freeport Sulphur Co.
Texas Gulf Sulphur Co.

RUBBER
Firestone Tire & Rubber
Goodrich, B. F., Co.
Goodyear Tire & Rubber
U. S. Rubber Co.

PAINTS, PIGMENTS and INK
Eagle-Picher Co.
Glidden Co.
Interchemical Corp.
National Lead Co.
St. Joseph Lead Co.
Sherwin-Williams Co.
Sun Chemical Corp.

FOODSTUFFS, PROCESSED
Corn Products Refg. Co.
General Foods Corp.
General Mills
Penick & Ford

FOODSTUFFS (Cont.)
Pillsbury Mills
Quaker Oats Co.
Standard Brands

PHARMACEUTICALS and FINE CHEMICALS
Abbott Laboratories
American Cyanamid Co.
American Home Products
Bristol Myers Co.
Heyden Chemical Corp.
Mead Johnson & Co.
Merck & Co.
Parke, Davis & Co.
Pfizer, Chas., & Co.
Sharpe & Dohme
Smith, Kline & French
Squibb, E. R., & Sons
Sterling Drug Co.
Vick Chemical Co.

SOAP and DETERGENTS
Colgate-Palmolive-Peet
Procter & Gamble Co.

BEVERAGES, DISTILLED
Distillers Corp.-Seagrams
National Distillers
Publicker Industries
Schenley Industries

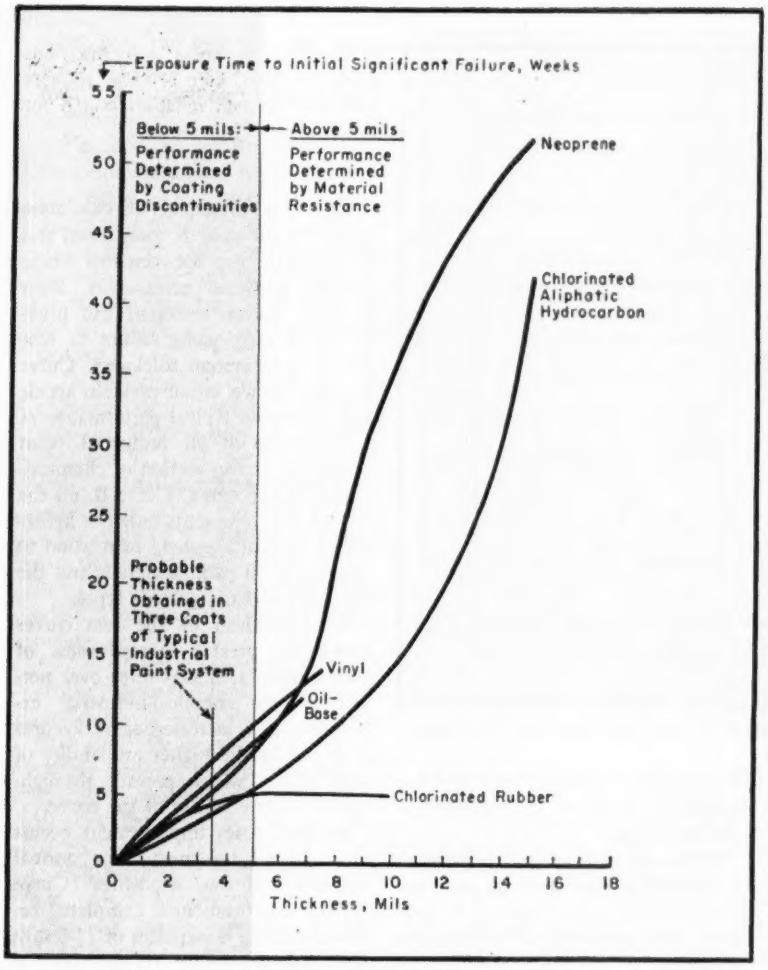
Exposure Time to Initial Significant Failure, Weeks
Below 5 mils: Performance Determined by Coating Discontinuities
Above 5 mils Performance Determined by Material Resistance
Neoprene
Chlorinated Aliphatic Hydrocarbon
Probable Thickness Obtained in Three Coats of Typical Industrial Paint System
Vinyl
Oil-Base
Chlorinated Rubber
Thickness, Mils

Fig. 1.–INITIAL FAILURE vs. THICKNESS for coatings in an HCl atmosphere.

Why Go to Thick Protective Coatings?

TWO GOOD REASONS:

Under 5 mils thickness, failure of your equipment will be rapid regardless of coating type—due to poor coverage over hard-to-coat areas.

Above 5 mils, coating performance can be controlled—and it depends primarily on resistance to the environment of the coating that you select.

by R. R. PIERCE

IMPORTANCE of thick protective coatings for use in aggressive chemical-industrial atmospheres is not yet generally realized. But the fact remains that a paint job that just looks good and is otherwise O. K. will be serviceable only if it is applied thick enough.

Fig. 1 takes a common aggressive chemical-industrial atmosphere and shows just how vital this matter of thickness is. Note in Fig. 1 that the probable thickness you will end up with—by selecting a proprietary three-coat system at random from among currently-available industrial paint materials—is only 3½ mils. No coating you select of this thickness will last for as much as ten weeks in this atmosphere.

Fortunately, there are coating systems available in some of the basic resin types which will yield thicknesses above 5 mils in the economical three-coat applications. This makes it possible to take advantage of the chemical resistance offered by the better materials. Of course, what is good for one atmosphere, may be no good for another.

In the article "Key to Savings in Painting Costs"* bearing on this same subject, supporting data were presented as composite data. That is, performances of all common industrial types of maintenance paints were averaged out. Not shown were the performances of coatings of any specific type against any given atmosphere.

In here presenting the data for hydrochloric acid atmospheres only, we reveal further original findings that will help in your selection problem—whether or not you are concerned specifically with hydrochloric acid.

EVALUATION PROCEDURE

So that results will be representative of chemical-industrial hydrochloric acid atmospheres, we have studied the performance of each coating system in six industrial hydrochloric acid atmospheres, each having in common hydrochloric acid fumes

* Based on performance of 62 industrial paint materials in 14 chemical-industrial exposures. A summary of 337 performance evaluations. *Chem. Eng.*, May 1952, p. 149.

R. R. PIERCE is *corrosion engineer for the Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.*

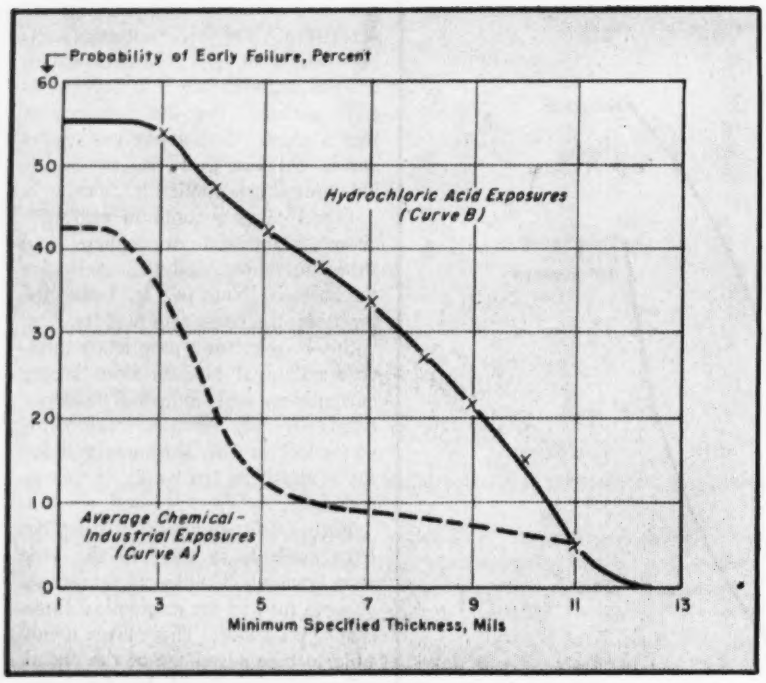

Fig. 2—PROBABILITY of early failure. HCl vs. avg. chem.-industrial atmosphere.

or vapors as the predominant metal corrodant. These atmospheres range in aggressiveness from locations directly over and in the fumes from acid leaching vats, through chlorination processes, to weathering exposures adjacent to and outside hydrochloric acid process units.

Instead of the ten basic types of coatings studied in the previous article,[8] we have selected five basic types for study.

Three of these types are typical industrial coating types in wide industrial use: the vinyls, the chlorinated rubbers, and oil-base paints. These are also representative of low or medium-build coatings.

For contrast we have included two additional types; namely the neoprenes and chlorinated aliphatic hydrocarbon types, which represent high-build coatings.

So that the results may be representative of the type, within each group we have included three or more systems which we felt representative. Within the oil-base group ten proprietary paint systems were included, of which five were typical alkyds, two were phenolic-tung oil compositions, two were epoxy esters, and one a soft oil formulation. Results presented for this group are from 38 performance determinations.

Within the vinyl group are included 11 proprietary vinyl systems, and the data presented is the result of 34 individual determinations of coating performance.

Included within the chlorinated rubber group are 39 performance determinations for six proprietary chlorinated rubber systems. Included with the neoprene group are seven proprietary neoprene systems, resulting from 24 individual determinations of performance. Included within the group of chlorinated aliphatic hydrocarbons are three proprietary systems, as a result of 15 evaluations of performance.

We thus have in this study the performance of 30 proprietary systems, representing five generic types, against hydrochloric atmosphere exposures. Data is a result of 150 individual performance determinations.

In all cases the materials were exposed as three-coat systems, applied as recommended by the manufacturer. Inhibitive primes were specified and used in most cases. Although similar determinations were made over corroded surfaces, they are not reported here—since thickness determinations upon corroded, wire brushed surfaces were not deemed reliable enough for this study.

RESULTS

Fig. 2 is presented at this time purely for the sake of comparison and to bridge the gap between this article and our previous presentation. Both of these curves represent the probability of early paint failure in relation to total system thickness. Curve A is that shown in our previous article and represents typical performance of a composite of all industrial paint systems in a cross-section of chemical-industrial exposures. Curve B, on the other hand, represents only our hydrochloric acid atmosphere in relation to only those 30 paint materials and the five selected basic coating types.

A comparison of the two curves shows the greater aggressiveness of hydrochloric acid exposures over normal average chemical-industrial exposures. This increased aggressiveness is shown by the higher probability of early failure which prevails throughout the entire course of the curve.

In both cases improvement occurs at a 2½-mil thickness. For normal chemical-industrial exposures (Curve A) the improvement is completed between coating thicknesses of 2½-6 mils and little advantage occurs above 6 mils. In the case of hydrochloric acid exposures, however, this same improvement is noted above a 2½-mil thickness, although improvement is not complete until thicknesses above 10 mils are obtained. This again is an indication of the greater aggressive action of the hydrochloric acid exposures.

Another contributing factor to the deviation between the two curves is the reduced number of paint materials used in this hydrochloric acid study. Curve A includes 62 proprietary paint materials representing ten generic types. The hydrochloric acid study represents 30 proprietary materials from only 5 generic types. It is entirely possible that if coating materials of the residual five generic types were included in this study, Curve B would parallel more closely the contours of Curve A. Even in such a case, the probability of early failure would

most likely be higher in the case of hydrochloric acid exposures, due to the greater aggressiveness of these atmospheres.

Fig. 2 would seem to indicate that the 5-mil minimum thickness recommendation, demonstrated by Curve A and recommended in our previous article, has no universal significance. It would also seem to indicate the minimum thickness to prevent premature failure will vary with type of exposure.

In the case of hydrochloric acid exposure, 10 mils are required to obtain the same quality of protection obtained by 5 mils in average chemical-industrial exposures. That a 5-mil break point is not shown in Curve B is the result of the method of plotting this data. As will be disclosed later, this does not belie the significance of a 5-mil minimum thickness requirement.

It must be remembered that both of the curves of Fig. 2 present the probability of early failure. An arbitrary value for early failure had previously been set as the occurrence of significant and visible failure within a 10-week exposure period on KTA panels.

This method of presentation therefore only designates minimum thicknesses for coating materials to overcome failure within this period, and gives no indication of optimum thicknesses required to obtain most durable paint life for any given exposure. It is recognized that coating or lining thicknesses should be increased with corrosive aggressiveness of the environment, and the optimum thickness to obtain most economical durable protection will vary with such aggressiveness. By re-presenting exactly the same data from which Curve B was constructed, we will be able to again see within this data the significance of the 5-mil minimum thickness.

For the purposes of this study it will be of greater value to plot the absolute time, in weeks, to inception of significant early failure against coating thickness. These relationships are shown in Fig. 3.

It may be readily seen from Fig. 3 that the low or medium build coatings normally range in application from 2-10 mils thickness, whereas the high-build coatings may be applied in thicknesses between 2-16 mils, in a three-coat system. Consequently the curves for the low build thicknesses rarely exceed system thicknesses of 10 mils. It is very probable that performance of such materials above 10 mils will show marked improvements. To obtain such high system thicknesses with these low build coatings, however, would require such a multiplicity of coats as to make these materials uneconomical from a labor standpoint for industrial maintenance painting.

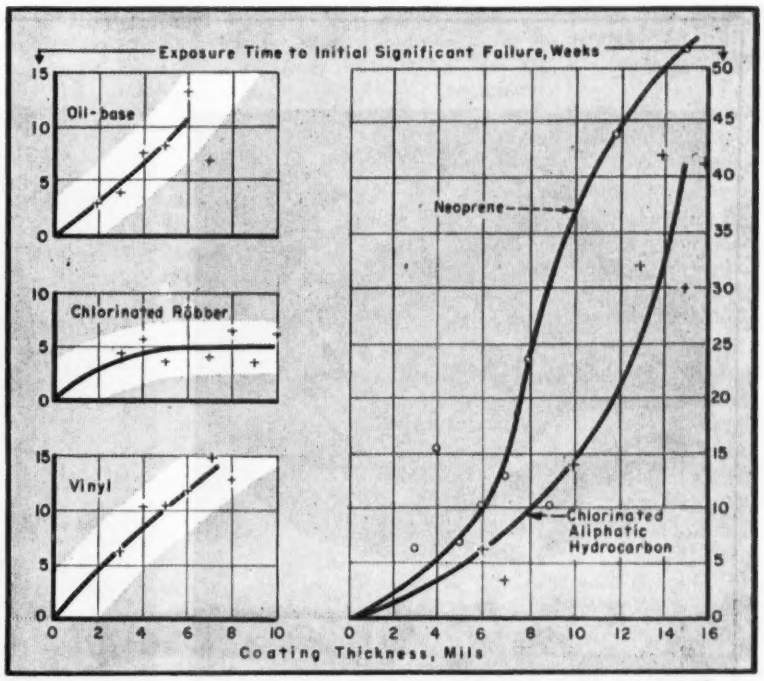

Fig. 3—FAILURE VS. THICKNESS. Left: low and med.-build paints. Rt.: hi-build.

These relationships represent the performance of these generic types in a single chemical-industrial exposure, hydrochloric acid. It is recognized that each basic type of coating system has specific limitations and weaknesses for any given exposure, and most materials are especially suited for specific exposures. Therefore the poor showing in this study of chlorinated rubber, and possibly of other types, should not be construed to mean that these types of coatings are of no value for other chemical-industrial maintenance purposes. Those materials which give a poor performance in this test may well be the preferred system for other types of exposures. Conversely, those systems which give best performance under these hydrochloric acid conditions may fail rapidly if exposed to common chemical-industrial exposures of entirely different nature.

In Fig. 1 we have superimposed the curves of Fig. 3 for direct comparison. Fig. 1 demonstrates that there is not significant difference in the performance of any coating system, regardless of its type or base, below a total system thickness of 5 mils. It is only when coating thicknesses are applied at 5-mils thickness or greater that the inherent properties and weaknesses of that system or type will become evident.

In other words, below coating thicknesses of 5 mils all coating systems, regardless of generic type or material composition, will perform substantially equally and poorly. At 5-mil thickness or above, however, the characteristic strength or limitations of each system for any given exposure will become evident. This data therefore confirms the recommendations of the previous article in which it was proposed that, for durable paint protection, coating systems should never be applied in total system thicknesses of less than 5 mils. At that time it

IN CHEMICAL EXPOSURES, paint failure starts at edges, crevices and welds. Then it spreads to destroy entire paint film as at left above. Right: KTA test panel used to predict performance of coatings in aggressive chem.-industrial exposures.

Problems of Chemical Industry Are Unique

In the aggressive atmospheres of the chemical industry, maintenance paints do not have opportunity to fail by those normal mechanisms of paint film deterioration such as over-polymerization, over-oxidation, depolymerization, or chalking deterioration. In chemical exposures paint failure usually occurs through early exposure of base steel at discontinuities or weaknesses in the coating film, and progressive destruction of the adjacent sound coating by the undercutting action of the corrosives in the atmosphere, or by the prying action of the resulting corrosion products.

Thus the ability of a maintenance coating to protect in these atmospheres is dependent upon its ability to cover, in adequate protective thicknesses, all surface areas and irregularities and penetrate into crevices and corners without pinholing or air-entrapment.

For this reason evaluations of the performance of paints and coatings by conventional panel methods—in which points of early coating failure such as edges, prominences, welds, and crevices are not reproduced, and by which ultimate film degradation only is observed—usually do not correlate well with actual performance of paints and coatings in chemical-industrial use.

Consequently the chemical industry has adopted the use of test panels[1] that reproduce all the common structural irregularities such as sharp edges, prominences, welds and crevices. Use of these panels and results obtained during a 5-year evaluation program conducted for the last five years by Pennsalt are described in a previous article.[2] The findings reported herein are based upon results obtained by use of these same test panels and evaluation procedures.

was not made clear to all that the inherent differences in performance of any respective material would become apparent only above the 5 mils thickness level.

SIGNIFICANCE

Significance of this data lies in the fact that below 5 mils total system thickness, paint performance is independent of the nature of the paint. This presupposes therefore that paint applications below this thickness level fail through some common cause. This common cause must be entirely independent of coating system composition and type.

Thickness measurements used in this study were obtained by a magnetic gage. These thicknesses are best determined upon flat surfaces. In industrial maintenance painting sharp edges, prominences, welds, projections, rivets, and crevices are almost always present in varying degrees. Thickness measurements reported here are not the thicknesses over these surface irregularities. Surface tension of any liquid will cause paint to pull thin over the high points of sharp edges, prominences, projections. It will cause paint to pile up excessively in crevices and inside corners, usually entrapping air bubbles in the process. Continued use of thickness measurements on plane surfaces, however, is justified in that it is difficult, if not impossible, to quickly determine thicknesses over prominences during field paint applications.

Actually, then, the minimum thicknesses recommended in this report must be considered as thicknesses—which measured on the plane surfaces—will give adequate protection at some related lesser thickness over irregularities on the base surface.

George Young and others[3] have ably demonstrated, by continuity measurements at various thickness levels over plane surfaces, that coating thicknesses in excess of 1 mil are very rarely required for continuity over steel surfaces. We have found that coating thicknesses of no less than 5 mils, as measured on the flat or plane surfaces, are required for complete continuity in painting over industrial surfaces which contain sharp edges, prominences, crevices and welds.

Correlating the results of these studies, we must arrive at the conclusion that 5 mils are required on the plane areas to insure that coating thicknesses over sharp edges, prominences and welds will be in excess of the 1-mil figure determined by the former investigators. Therefore, below 5-mil plane thickness, discontinuities due to deficient coating must be present over points of early surface failure represented by sharp edges, prominences and welds.

This supposition correlates very well with the data, in that discontinuities will cause failures which will be entirely independent of coating composition and types. Following this reasoning to its logical conclusion then, above 5 mils complete coating continuity has been established over all surfaces and surface irregularities—and from this point on performance is predicated upon the inherent resistance of the coating material to the environment. This conclusion is in accordance with exposure experience presented here.

With this thought in mind let us again analyze the data presented in Fig. 1. In the three-coat systems previously established[2] as a maximum for economical industrial plant maintenance, the oil-base coatings and the vinyls—due to their relatively low build—can obtain but little excess of thickness over that required to establish continuity over all surface irregularities. Thus they produce thin, although continuous, coatings over these surface irregularities. To obtain sufficient barrier thickness over these points of early failure with these materials, it will be necessary to use considerably more than three coats.

On the other hand, chlorinated rubber systems potentially can build up to protective thicknesses. But for these exposures they have shown characteristic non-resistances which preclude their use, regardless of thickness and coating continuity.

Neoprene materials, which here and elsewhere have demonstrated their ability to handle hydrochloric acid exposures, represent typical performance of hydrochloric acid-resistant coatings over the entire thickness range. Performance of the chlorinated aliphatic materials represents a durable high-build coating. However, they do not possess quite the resistance to hydrochloric acid that is demonstrated by the neoprenes.

Chlorinated aliphatic materials seem to show a significant lesser protective ability in the thicknesses ranging below 6 mils than is demonstrated by all of the other groups under comparison. It is felt that this is not experimental error, but is significant. These compositions are plastic liquids, in other words they are thixotropic. For this reason they do not flow-out after application as do materials of the other four groups. After application the material will not fill low spots or discontinuities in the applied coating film. It is therefore reasonable that these materials will have a higher incidence of coating discontinuity at low coating thicknesses. As the applied thickness exceeds 6 mils, however, sufficient coating material is available to cover over all discontinuities and to give ample protective thickness over all areas on the metal surface.

It has previously been demonstrated[2] by the application of 62 industrial paint materials that the average three-coat thickness, which can be readily obtained by industrial painters with these materials, will average 3½ mils. System thicknesses of this magnitude are inadequate for durable maintenance protection, and are insufficient to eliminate initial discontinuities in the protective coating. Random procurement of industrial paints, therefore, will result in three-coat applications of deficient coating thickness—which require additional coats above this three-coat minimum to yield durable protection. This requirement for an excess of coats will result in excessive labor costs for the application.

Fortunately there are many good resistant paints made for chemical-industrial exposures which will yield thicknesses above 5 mils in three-coat applications. These high-build materials are available in most of the generic types.

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Engineering for Today's Chemical Plants

Since the start of the last century Du Pont has been developing techniques of engineering practice and organization that are well worth study throughout chemical process industries.

RAYMOND P. GENEREAUX

Organization of engineering activities has been evolving for more than 150 years at Du Pont. It is still evolving. At the same time, a certain philosophy of the successful privately owned chemical enterprise has grown up. I should like to give you some idea of each—our concept of the successful enterprise, and our method of working toward it, from the initial idea, to the new plant in being.

Chemical Plant Characteristics

There are basic requirements that pervade any chemical plant project throughout its life. First and foremost is the challenging and changing demand of economics. The prime items of plant economics are low capital investment, low working capital, low manufacturing and sales cost, and plant capacity commensurate with product demand. In Du Pont, the final measure of effectiveness is return on investment. We define return on investment as net earnings after all expenses and taxes divided by the total investment, which includes both working capital and permanent investment.

The endeavor is haunted at all times by the threat of obsolescence of product and manufacturing facilities. So, everyone involved in a project must be alert to means for prolonging the useful life of the facilities and the continuing economic success of the venture. Research must continue. All operating costs must receive critical study so that reductions can be effected promptly. A plant improvement program must be devised to assure economic modifications to the equipment.

Operability of the plant must be woven into the design. This means a carefully studied arrangement of equipment and controls and flow of materials. There must be an economical minimum of operators. Inventories in raw, intermediate, and finished materials must be economical but in operable balance. Otherwise, the working capital would be excessive. The design must permit low-cost maintenance. It must provide flexibility to permit economical modifications to process and capacity increases in the future. It means a plant with safety designed into it.

An essential feature of any chemical enterprise is its vulnerability to loss of yield. Because it is generally a high-capacity, high-cost facility, a mistake in plant operation can eat up a lot of money quickly. Operators and automatic devices must function dependably and earn their way.

Steps in a Project

Accomplishment of a project requires four major types of work: research, economic evaluations, development, and the design and construction of the facilities. Essential to success is the proper timing of each element in relation to all others. While the chemical and physical research is progressing, the engineers must start accumulating the basic data that are required for design purposes. They must help influence the research and development to assure feasibility of the process and adequate information. This would cover the chemical and mechanical parts of the process, with material and heat balances. It would include process conditions such as temperature and pressure ranges, cycles, methods of addition and separation. A necessary evaluation is continuous versus batch operation. Preliminary selection of materials of construction should be made to reveal critical problems for study. During this time the design engineers should become acquainted with the broad aspects of the project, particularly the process and product. They should secure firsthand background in the research and development. This knowledge will enable them to suggest types of pilot-plant equipment and the kind of design data that will be required.

A variety of economic studies is made simultaneously and several times during the life of a project. Studies cover availability of raw materials, forecasting of operating costs and sales costs, market analysis, estimates of capital investment, and predictions of return on investment. These studies are imperative so that judgment may be made from time to time whether or not to proceed.

Development includes special attention to new types of machinery and critical process features. Another major development is plant site location. Many factors are evaluated for several prospective sites to assure wise selection. The trend in our company has been to locate new plants away from large cities. The opportunity in rural communities proves to be superior for good community and hence good public relations.

Creation of the facilities themselves

R. P. GENEREAUX is a special assistant to the engineering department of the Du Pont Co., at Wilmington, Del. *This article is slightly condensed from one the author gave before the ASME Management Division's symposium on Automation, Dec. 1, 1953. The complete symposium is to be available shortly from the Society.*

requires design, procurement, and construction. Let us see how this engineering is done.

The process research is progressing. A study has demonstrated the need and scope of process development on a pilot plant or semi-works scale. This work is started and the design force begins the full-scale preliminary design to crystallize a balanced plant. This step produces a broad definition of character and scope of facilities.

A requisite is frequent consultation with plant operating people to make certain their experience is incorporated to the best advantage.

Use of the latest technology is mandatory. To be certain of this, there must be effective communication of new techniques and continuing education of the engineers. Alternative types of equipment and materials of construction must be compared as to suitability and simplicity, and evaluated as to original cost and maintenance.

The prime items of plant economics are low capital investment, low working capital, low manufacturing and sales cost, and plant capacity commensurate with product demand . . . The final measure of effectiveness is return on investment.

The Productive 45 Percent

At Du Pont manufacturing buildings and equipment are generally 60 percent of the cost of the plant. Utilities and other service facilities account for the remaining 40 percent. The 60 percent for manufacturing facilities breaks down into 15 percent for buildings, and 45 percent for the equipment that really produces the product. In other words, less than half the cost of a plant is for the actual manufacturing equipment. We recognize the need to improve this.

During preliminary design the engineering flow sheet, or equipment and piping diagram, comes into being. It shows all equipment, drives and auxilaries, pipelines, valves, and controls, indicating sizes and materials of construction. It serves as a basis of discussion between engineers, operating, process development, and research men, and can be modified until it meets all requirements. Consideration at all times needs to be given to the economic life of the equipment and the usual need to increase plant capacity after operation is established.

Following agreement on the equipment and accessories there is the preparation of a preliminary plant layout and arrangement drawings of the manufacturing buildings or areas. The arrangement must allow for orderly movement of materials, make effective use of operating manpower, and provide the best location for centralized controls. By placing a maximum of equipment outdoors, the housing of equipment can be minimized. The piping, equipment, and other items must be accessible for maintenance and repairs. Consideration must be given to health, fire, and explosion hazards, and to personal safety. Specialists in many engineering fields contribute to the best arrangement. Among them are electrical and power engineers, structural and civil engineers, industrial and safety engineers.

The process requirements for such services as steam, water, electricity, inert gas, fuel, refrigeration, and compressed air are then determined. Preliminary design is prepared for the process buildings with heating, ventilation, air conditioning, steam and electric service and lighting, plumbing, draining, etc. Here again many engineering skills are applied.

In addition to the process facilities, the service facilities are designed in a preliminary degree. They include, as required, a power plant, the water supply, the electrical power supply, warehouses, change houses, laboratories, gate houses, first-aid rooms, offices, cafeterias, fire protection, and safe waste disposal.

The final integrated plant layout can now be prepared with consideration for future expansion at a minimum of immediate expenditure. All foreseeable major items that future expansion may require should be placed on the preliminary layout. This consideration will at least avoid some future costly interferences or poor relationships of facilities. It also will produce a better layout for the immediate plant. Layout includes handling and storage of materials to and from the plant, the required docks, railroads, and roads. The layout shows outside pipelines, power lines, sewers, ditches, waste disposal facilities, fences, outside lighting, parking lots, fire fighting facilities, and so on, all arranged to avoid interferences and excessive cost. Each part should be considered on its own merits and in relation to other parts of the plant. Critical examination and considerable judgment are required to achieve a well-defined character and scope of work, and at the same time avoid detailed design before the basic design is set.

All the information thus developed is a definition of the scope of work for the final design. It also serves as the information for preparing a suitable estimate of total cost.

The Estimator's Job

Estimating is a special field relying largely on experience and up-to-date information on labor and material costs. With all this, there is no substitute for good sound judgment. Estimating is not the solution of a mathematical equation, as many unseasoned estimators learn to their consternation, and the Treasurer's distress! The estimator must have a broad knowledge of the proposed plant, of site conditions, and the availability and effectiveness of labor. He must have a sense of what is missing in what has been defined to him. It is seldom what is in the estimate, but often what is left out, that jeopardizes the venture. Discussion with the design and construction engineers can be of considerable value in reducing cost and achieving a reliable estimate.

At this stage of project development, with the plant defined, a dependable estimate prepared, and return on investment determined, construction may be authorized.

Design: Two Parts

The final design can be considered in two parts: design for purchasing, and design for construction.

Design for purchasing includes preparation of detailed drawings for the fabrication of special equipment, and selection and specification of conventional equipment and materials.

An essential feature of any chemical enterprise is its vulnerability to loss of yield. Because it is generally a high-capacity, high-cost facility, a mistake in plant operation can eat up a lot of money . . . Faulty installations causing losses of production during startup may cause several months idle time, or require earnings from several years at capacity operation to offset such faults.

Functions involved in procurement are: first, the selection of bidders, which presumes knowledge of their capacity and capabilities, and sometimes of their reliability in meeting commitments. The next step is obtaining quotations. Then follows the comparison of quotations on the items of price, delivery date, and conformity with specifications. Next, the order is placed. When the vendor's certified drawings are received, they are checked and approved. The final step is inspection in the vendor's shop. These functions require close coordination between design, construction, and purchasing personnel.

Design for construction includes preparation of all the detailed drawings needed for field construction, and of specifications for materials to be procured by the construction forces.

Timing is an important factor for earliest completion of the plant for operation. Timing is important throughout all phases of research, process development, design, estimating, procurement, and construction. Interlocking schedules, tight enough to show up bottlenecks, must be prepared and reviewed at intervals to assure that first things come first.

The demand for quick plant startup and early realization of design capacity dictates meticulous construction. Faulty installations, causing losses of production during startup, may cause several months idle time or even require earnings from several years at capacity operation to offset such faults.

When the plant startup finally comes, pretrained operating personnel, aided by the design and consulting engineers, can commence earning the return on investment. This is the time when high-quality teamwork in research and engineering really shows its worth.

How do we organize an engineering force to bring the right talent to bear at the right time? For one thing, we elect to do most of our own engineering. We do not have to wait for firm bids before commencing procurement and construction. A proprietary interest on the part of the engineers causes us to do a better job. Important, too, is the continuing association of engineers with the operating people.

Our Engineering Department has five divisions. One is Development Engineering. Its primary function is research and development in the fields of chemical and mechanical engineering, applied physics for process control, and materials of construction. These research men have work programs with a bearing on immediate problems, and a program of fundamental research hoped to have future value. They not only feed their information to the design engineers in reports, but also assist directly in the solution of difficult engineering problems in current design and construction projects.

Our Engineering Service Division consists of a field section and a consulting section. Younger engineers are assigned to plants for work on studies for improving capacity and quality, the reduction of operating costs, and also to work on new process developments. The average field engineer spends about three years at each of three or more plants. This group of men is a prime source of experienced and specially trained engineers for assignment to more responsible work in design, construction, research, and consultation.

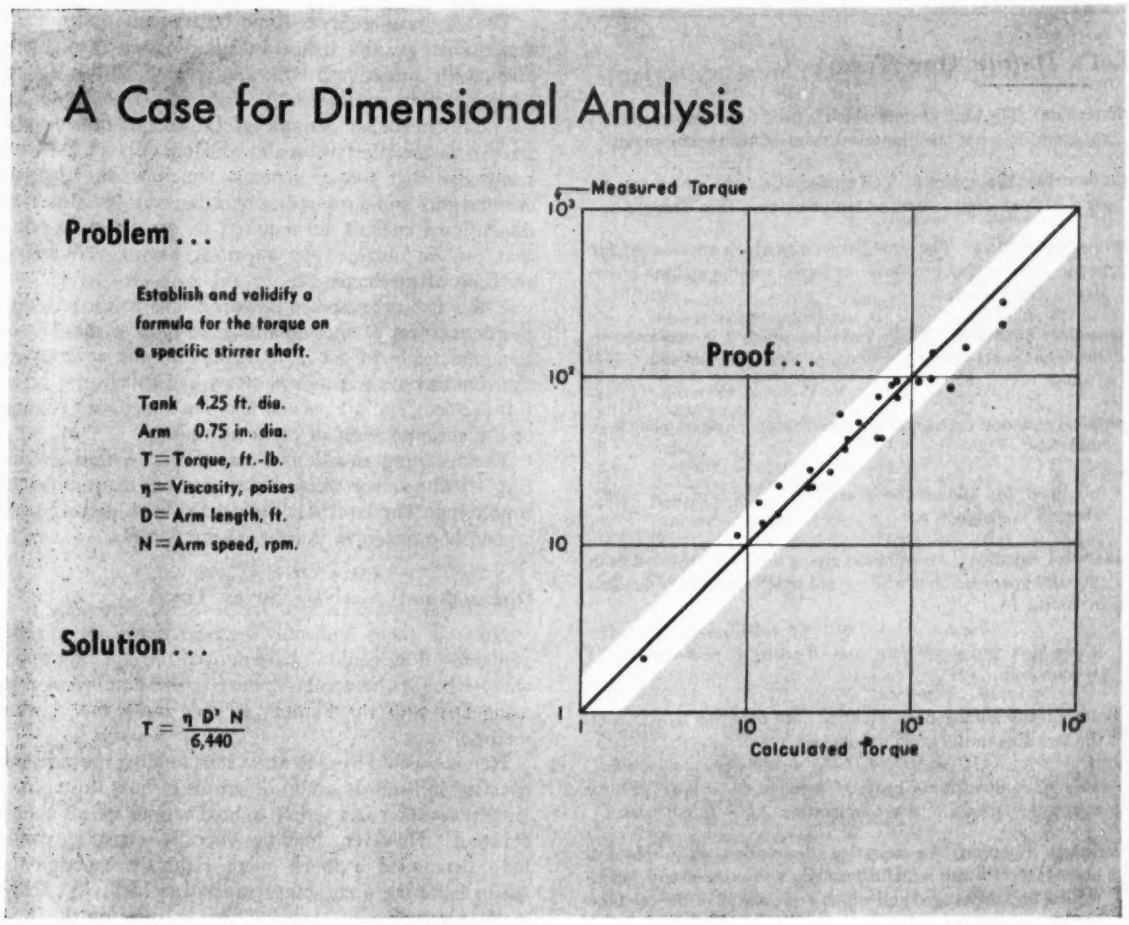
The consulting section comprises groups of experienced specialists with younger assistants. They cover all fields of engineering involved in the company's business, including chemical engineering, mechanical engineering, instrumentation, engineering materials, maintenance, materials handling, utilities such as steam and electrical generation and distribution, refrigeration and air conditioning, water supply and treatment, prevention of air and stream pollution, and industrial engineering. Their work is on problems for existing plants and assistance to design for new plants.

The Design Division correlates the engineering effort that results in drawings and specifications for construction. Our broad diversification of chemical manufacture has prompted the establishment of ten industrial departments, each having broad responsibilities in particular fields of products. In our Design Division, we assign a design project manager to supervise all of the design work done for a given industrial department. This permits him to become thoroughly familiar with the people and developments of that department.

Construction commences when design is about 60 percent complete. This dovetails the entire project and hastens the time of startup. Construction personnel review design as it is developed, make constructive suggestions, and thus are able to sequence their work more knowingly. Design personnel visit the construction site to facilitate interpretations and learn how to do a better job next time.

Our means for bringing all these engineering functions into close harmony are many. A prime one is interchange of personnel. Another lies in our planning and scheduling, which is done by the people who are to do the work. Another is in a training program and in bridging the engineer's change from academic to industrial work. Horizons widen, and one's own work ceases to be the most important; it becomes properly integrated to the whole.

. . . Construction personnel review design as it is developed, make constructive suggestions, and thus are able to sequence their work more knowingly. Design personnel visit the construction site to facilitate interpretations and learn how to do a better job next time.



Predicting the form of the final relation by dimensional analysis reduced the actual experimental work to a few runs.

Put Dimensional Analysis to Work

The practical chemical engineer could find a use for dimensional analysis if he had a step-by-step outline of the procedures. Here's how to use this basic engineering tool.

J. E. PIERCE

Dimensional analysis is a tool which can be very useful to the practicing chemical engineer. It is simple, demanding little in the way of mathematical training. Actually it's nothing but a shorthand system for dealing systematically with the relations between units of measurement of physical quantities.

Bridgman has written a treatise from a fundamental approach (1). Several books (2, 3, 4, 6, 8) include chapters on the subject. Two recent texts (5, 7) are suitable for college courses. There are numerous examples of successful application in the literature (9, 10). However, it's slow, heavy work to dig out a procedure to use for a particular problem and the examples in the texts presuppose an understanding of the subject.

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Let's Define Our Terms . . .

dimension The kind of unit which is used to measure a physical quantity—not the numerical value of the measurement.

fundamental dimensions The most basic units which can be used such as length, time or temperature. (See Table).

primary quantities The most basic units which are selected for use in a particular problem—as force, volume or heat quantity. (See Table).

secondary quantities Those variables which it is necessary to consider to completely describe a physical phenomenon (See Table).

physical equation An equation describing a physical phenomenon. As:

$$S + u = gt + \tfrac{1}{2}gt^2$$

(obtained by adding the equations $S = gt$ and $u = \tfrac{1}{2}gt^2$) where S = distance.

adequate equation An equation giving a true relation between physical quantities, but which is not true for arbitrary changes in units. As:

$$\log p = (C - 1{,}680)/(\theta + 230)$$

where p = vapor pressure, mm. Hg abs.; C = a constant; θ = temperature, °C.

dimensionally homogenous equation An equation in which all the terms have the same dimensions. As:

$$Q = MC_p(\theta_1 - \theta_2) + Mh_{fg}$$

where Q = quantity of heat; M = mass; C_p = heat capacity at constant pressure; θ is temperature; h_{fg} = latent heat.

complete equation An equation descriptive of a physical phenomenon which remains true when the size of any fundamental unit is changed and which expresses all of the relations between quantities. As:

$$t = C[(\rho r^3/\sigma)]^{1/2},$$

where C = a constant; ρ = density; r = radius; σ = surface tension; t = time.

dimensionless constant In a physical equation a constant which has dimensions and which must change in numerical value when the fundamental units are changed. As:

$$F = (GM_1M_2)/d^2,$$

where G is the gravitational constant; F = force; M = mass; d = distance.

dimensionless group A combination of primary and secondary quantities so arranged that its numerical value does not change with change from one self-consistent system of units to another. As:

$Du\rho/\mu$ (Reynolds' number).

self-consistent system of units A system in which any particular fundamental dimension is measured in the same way in every case.

complete set of dimensionless groups A set of dimensionless products of given variables is complete, if each product in the set is independent of the others, and every other product of the variables is a product of powers of dimensionless products in the set.

similar physical systems Corresponding ratios in the systems of geometric, kinematic and dynamic units possess a factor of proportionality.

The chemical engineer could occasionally find use for dimensional analysis if he could find a step-by-step outline of the procedures. It's the purpose of this article to give such an outline.

We've shown an example of the use of dimensional analysis in the illustration above. Here only an intuitive knowledge that torque depends somehow on viscosity, arm length, and arm rpm., plus the manipulations of dimensional analysis are required to get the same result that can be obtained by a person with a real understanding of mechanics.

It was not necessary to make 27 runs to demonstrate the correctness of the equation. This large number of runs was made to get a better idea of the accuracy of the constant. A statistician, if we had called one in on this problem, could have attained a more definite opinion of the accuracy without as many runs.

The resulting equation, $T = \eta D^3N/6{,}440$ is simple. But it will produce information covering many different conditions. The equation could have been derived from a good knowledge of theoretical mechanics.

Dimensional Analysis Saves Time

Now, if there had only been dimensional analysis available—if we couldn't have derived the equation otherwise—what is the contrast between the number of runs using DA with the number of runs using the classical method?

Here we would have to make runs holding the variables constant in turn. It would be simple to hold various arm lengths constant and simple to hold various speeds almost constant. However, holding viscosity constant would have demanded a much more elaborate experimental set-up involving a constant-temperature bath. With DA it is only necessary to know the viscosity at the time of the readings, not to know that it is constant throughout an entire series of runs. Viscosity of the material used doubles with a temperature decrease of about 5 deg. C.

We estimate that it would have taken a minimum of 48 experiments to determine the form of the relation, without attaining an idea of the accuracy of the constant. This also assumes the great good fortune that experimental inaccuracies would not be large enough to deceive as to the form of the curves. When the form is determined the accuracy of the constant can be evaluated as carefully as desired.

There are other applications that can save you time and effort. You can use dimensional analysis for these and other engineering jobs:

- Checking equations
- Changing units
- Deriving formulas
- Fitting formulas to experimental data
- Analyzing physical systems by the use of models
- Planning systematic experimentation

We've outlined below the procedures to follow when using dimensional analysis for each of these purposes. In addition to the step-by-step outline you'll find some worked out examples.

How to Check Equations

Many times chemical engineers will write down an equation, add up the terms and then look at the answer in amazement. It's the old story about adding apples and pears. You can't. Before you can use an equation the terms on both sides must have equivalent dimensions.

To see if an equation is dimensionally homogenous, follow these steps:

1. Write the equation.
2. Write the symbols for the fundamental units in place of each quantity in the equation.
3. Reduce each symbol algebraically to its simplest form.
4. Inspect the results to see if all the terms have the same dimensions.

Example—The expression below represents the amount of heat necessary to raise a liquid to its boiling point and vaporize it. Is the equation dimensionally correct?

$$Q = MC_p\,(\theta_1 - \theta_2) + Mh_{fg}$$

Solution—We'll write the equation, substitute and inspect the results.

$$Q = MC_p\,(\theta_1 - \theta_2) + Mh_{fg}$$

$$Q = (M)\,(QM^{-1}\,\theta^{-1})\,(\theta_1 - \theta_2) + (M)\,(QM^{-1})$$

$$= (Q\theta^{-1})\,(\theta) + Q$$

$$Q = Q + Q$$

Heat = Heat

How to Change Units

Engineers are frequently faced with the problem of changing the magnitude of units, or changing units from one system to another. Here's a simple method for changing the magnitude:

1. Write the dimension using the name of the quantity being considered.
2. Replace each name by its equivalent in terms of the new unit you want.

Example 1—Reduce ft.-lb./hr. to ergs/sec.

Solution—We'll write out the names of the terms and make appropriate substitutions.

ft.-lb./hr. = (feet) (pounds)/(hour)

= (30.48 cm.) (444,820 dynes)/(3,600 sec.)

= 3,766.1 cm.-dynes/sec.

ft.-lb./hr. = 3,766.1 ergs/sec.

If you want to change from one system to another, as from mass-length-time to force-length-time, proceed exactly as in Example 1. However, there are two limitations:

1. Each of the units in the new system must be independent of the others in the system. A system of units could not consist of a horsepower, a velocity and a force. The force unit could be obtained by dividing the horsepower by the velocity and couldn't be independent.

Quantities and Their Dimensions

Mechanical Quantities

Symbol	Quantity	System Name: Dynamic or Absolute	Static or Gravitational	Technical
	Fundamental Quantities	MLt	FLt	$FMLt$
L	Distance	L	L	L
M	Mass (absolute quantity)	M	$F\theta L^{-1}$	M
t	Time	t	t	t
F	Force (scale weight)	MLt^{-2}	F	F
g	Acceleration due to gravity	Lt^{-2}	Lt^{-2}	Lt^{-2}
g_c	Conversion factor, Ma/F	None	None	$MLF^{-1}t^{-2}$
a	Acceleration	Lt^{-2}	Lt^{-2}	Lt^{-2}
u	Velocity	Lt^{-1}	Lt^{-1}	Lt^{-1}
ρ	Density	ML^{-3}	$F\theta L^{-4}$	ML^{-3}
u	Viscosity, absolute	$ML^{-1}t^{-1}$	$Ft L^{-2}$	$Ft L^{-2}$
ν	Viscosity, kinematic	L^2t^{-1}	L^2t^{-1}	L^2t^{-1}
σ	Surface tension	Mt^{-2}	FL^{-1}	FL^{-1}
p	Pressure intensity	$ML^{-1}t^{-2}$	FL^{-2}	FL^{-2}
W	Work, energy	ML^2t^{-2}	FL	FL
P	Power	ML^2t^{-3}	FLt^{-1}	FLt^{-1}
e	Modulus of elasticity	$ML^{-1}t^{-2}$	FL^{-2}	FL^{-2}

Thermal Quantities

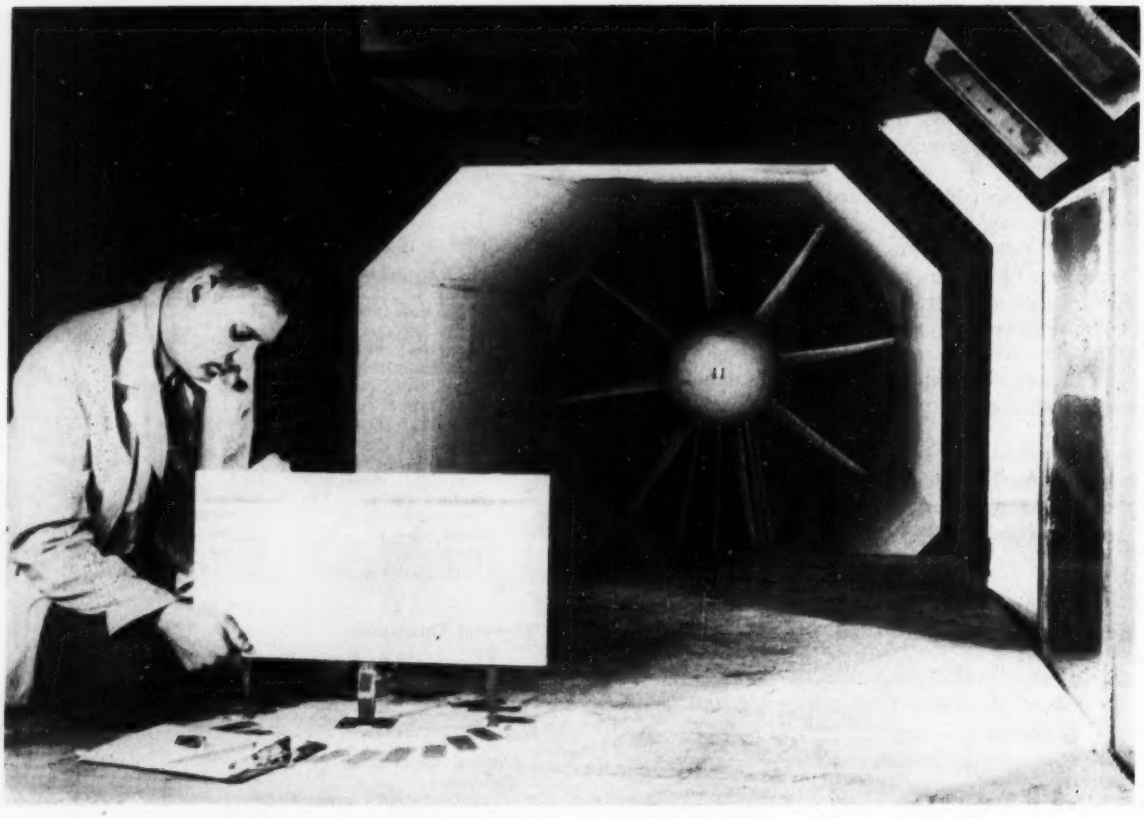
Symbol	Quantity	System Name: Dynamic or Absolute	Static or Gravitational	Technical
	Additional fundamental quantities	θ	θ	Q, θ
θ	Temperature	θ	θ	θ
Q	Quantity of heat	ML^2t^{-2}	FL	Q
C_p	Specific heat, constant pressure	$L^2t^{-2}\theta^{-1}$	$L^2t^{-2}\theta^{-1}$	$QM^{-1}\theta^{-1}$
U, h	Coefficient of heat transfer	$Mt^{-3}\theta^{-1}$	$FL^{-1}t^{-1}\theta^{-1}$	$Qt^{-1}L^{-2}\theta^{-1}$
K	Thermal conductivity	$MLt^{-3}\theta^{-1}$	$Ft^{-1}\theta^{-1}$	$Qt^{-1}L^{-1}\theta^{-1}$
J	Mechanical equivalent of heat	None	None	FLQ^{-1}
S	Entropy	$ML^2t^{-2}\theta^{-1}$	$FL\theta^{-1}$	$Q\theta^{-1}$

Dimensionless Groups

Group	Symbol	Name
$Du\rho/\mu$	N_{Re}, R	Reynolds' number
u^2/gD	N_{Fr}, F	Froude number
u/u_a	N_M	Mach number
hD/K	N_N	Nusselt number
$C_p\mu/K$	N_{Pr}	Prandtl number
$Du\rho C_p/K$	N_{Pe}	Peclet number
WC/KL	N_{Gz}	Graetz number
$L^3\rho^2\beta g\Delta t/\mu^2$	N_{Gr}	Grashof number
$h/cu\rho$	N_{St}	Stanton number
$(h/K)/(\mu^2/\rho^2g)^{1/3}$	N_{Co}	Condensation number
hL/K	N_{Bi}	Biot number
$k\tau/\rho C_pL^2$	N_{Fo}	Fourier number
$\mu/\rho D_v$	N_{Sc}	Schmidt number
$L^3\rho^2g\lambda/K\mu\,\Delta t$	N_{Co}	Number used in condensation of vapors
$\rho u^2/\epsilon_m$*	N_{Ca}	Cauchy number
$\rho Lu^2/\sigma$	N_{We}	Weber number
$F/\rho u^2L^2$	N_I	Inertia number
$Pg/\rho N^3D^5$	N_{Po}	Power number

* ϵ_m is the bulk modulus.

Nomenclature as per ASA-Z10.12-1946, "Letter Symbols For Chemical Engineering," American Standards Association.



Systematic experiments, planned by the use of dimensional analysis, measure the evaporation rate from a flat plate.

2. There must be the same number of fundamental units in the new system as in the old, otherwise there will be too many or too few relations to be satisfied between the units.

Example 2—Change viscosity in lb. of mass/sec.-ft. to lb. of force/sec.-sq. ft.

Solution—Viscosity can be expressed in lb. of mass/sec.-ft., but a lb. of force is equal to a lb. of mass multiplied by the acceleration due to gravity. Therefore,

$$\text{(lb. force)} = \text{(lb. mass)}\ (32.2\ \text{ft./sec.}^2)$$

$$\text{(lb. mass)} = \text{(lb. force)}\ (\text{ft.}^{-1})\ (\text{sec.}^2)$$

$$\text{Viscosity (new system)} = \frac{\text{(lb. force)}\ (\text{sec.}^2)\ (\text{ft.}^{-1})\ (\text{sec.}^{-1})\ (\text{ft.}^{-1})}{32.2}$$

$$\text{Viscosity} = \text{(lb. force)}\ (\text{sec.})\ (\text{ft.}^{-2})/32.2$$

Derivation of Formulas

There are certain steps which can help in developing an approach to describe a physical operation:

1. Decide what measurable quantities are necessary to the relation, from a general knowledge of the physics involved. (If any of the quantities are dimensionless such as strain, coefficient of friction, shape factor or number of blades, the quantity may be omitted from consideration up to Step 10.)

2. List these with their corresponding units. This is a list of secondary quantities.

3. List the number of primary quantities (basic units) needed to make up the units for the list of secondary quantities in Step 2.

4. Make certain that the units of the secondary quantities are expressed in the same fundamental quantities (See Table).

5. Subtract the number of primary quantities from the number of secondary quantities. The difference is the number of dimensionless groups which will be required to define the relation under consideration.

6. Reduce the number of dimensionless groups as far as possible (to one, if you can manage it) by increasing the number of primary quantities.

7. Select the variable for which you intend to solve. Call this variable A. Write f (secondary quantities) = A.

8. Make up the required number of dimensionless groups, by inspection if possible. (The ability to use inspection for assembling dimensionless groups varies with individuals. To some extent it's a matter of practice. It calls for skill in seeing combinations of powers of variables which will eliminate all dimensions.) Include variable A in only one of them. Include each of the secondary quantities in at least one group.

If the groups are not apparent they may be made up by setting up simultaneous equations to solve for the exponents of the secondary quantities.

Sometimes the groups don't work out as described above. They reason may be one of the following:

(a) An improper selection of variables has been made.
(b) The problem is inconsistent.
(c) Some factor has been omitted.
(d) An extra factor has been included.

9. Now write an equation in the form,

$$\pi_1 = f(\pi_2, \pi_3, \ldots \pi_n)$$

where π_1 is the dimensionless group containing the variable A, and π_2, π_3, etc. are other dimensionless groups.

10. Solve the equation in Step 9 for A.

$$A = \frac{A}{\pi_1} f(\pi_2, \pi_3, \ldots \pi_n)$$

This is the final derived formula.

Fitting a Formula to Experimental Data

If you have only one dimensionless group, try the form $A = (A/\pi_1)(K)$. Substitute values from your experimental data and solve for K. If the formula fits K will be a constant.

If you have more than one π, you can make any assumption you please as to the form of the relation. The one which generally proves to be most fruitful is to assume that the final equation will be in the form of the product of the dimensionless groups, each raised to some power.

Here then is a method for investigating the form of the final relations between the groups:

1. Hold the numerical value of all the groups constant except the key group containing variable A and one other group.

2. Plot values of the key group against corresponding values of the other group, using logarithmic graph paper. If the data plots as a straight line, the slope of the line is the unknown exponent of the second group.

3. Repeat the process for each group in turn.

If the procedure doesn't correlate the data, the relation is not in the form of the products of the powers. Then it remains to a person of considerable ingenuity to discover some other relation that does hold.

Physical Models Can Help

If it is known that a physical system is completely described by a particular set of variables, dimensionless groups can be made up by the procedure given in the "derivation of formulas" section.

Experiments can then be run on a model, or in a pilot plant, using the same numerical value for a dimensionless group as will be used in the full-scale operation. The relation between two such model groups may be plotted and the values of the individual secondary group variables computed for the full scale operation.

Planning Systematic Experimentation

If you've been able to derive a formula before experimenting on an operation it will be evident what data should be taken. We discussed this in detail above.

It should be remembered, however, that it is necessary to know in advance that all the pertinent variables have been considered. This is where the π Theorem can help out. As stated by Bridgman (1):

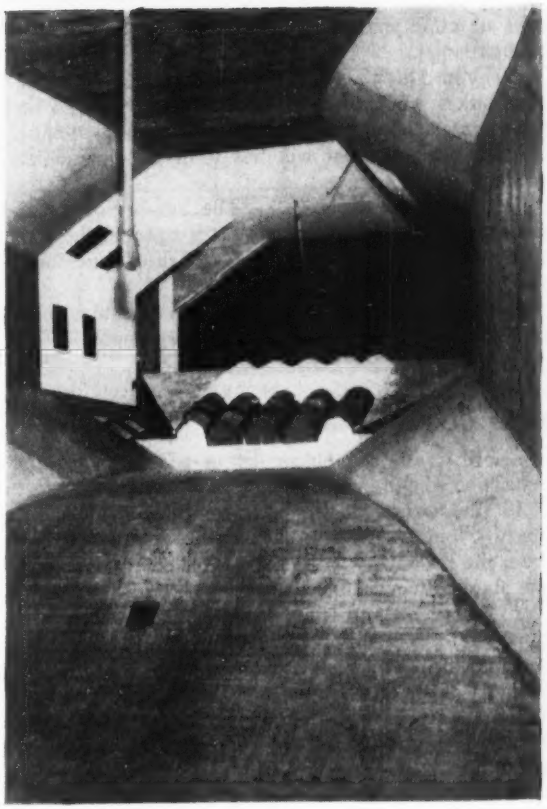
> "If the equation $f(\alpha, \beta, \gamma, \ldots) = 0$ is to be a complete equation, the solution has the form
>
> $$f(\pi_1, \pi_2, \ldots) = 0 \qquad \text{(b)}$$
>
> where the π's are the N-M independent products of the arguments α, β, . . . etc. which are dimensionless in the fundamental units."

Eq. (b) is simply a symbolic statement of the definition of a complete equation. Basically it amounts to stating that if dimensional analysis applies to a problem, it can be used on the problem.

The remainder of the π Theorem states that the number of dimensionless groups to be used in Eq. (b) is equal to the number of secondary quantities minus the number of primary quantities. This has been proved mathematically by several authors. This leads to Buckinham's Theorem which states,

> "If an equation is dimensionally homogenous, it can be reduced to a relationship among a complete set of dimensionless products." (8)

The π Theorem occasionally does not indicate the correct number of groups to use in a set. The following



Mass transfer studies from cylindric surfaces—applied DA.

rules are more precise, and both state the same rule in different ways.

(a) Van Driest's Rule (10)—"The number of dimensionless products in a complete set is equal to the total number of variables minus the maximum number of these variables that will not form a dimensionless product."

(b) Langhaar's Rule (8)—"The number of dimensionless products in a complete set is equal to the total number of variables minus the rank of their dimensional matrix."

Use of either rule will allow you to recognize those rare cases where the π Theorem does not apply.

Some General Restrictions

Before we try a problem, let us add a few general restrictions on the use of dimensional analysis.

1. Temperature like length, where measurement always starts at zero, must have a unit which is always measured from the same base. To avoid possible confusion, always use absolute temperature.

2. Independent variables in dimensional analysis are always restricted to positive values.

3. Each dimensionless group in a set should be independent of any of the others. A good criterion for this independence is that there should be, in each group, one secondary variable which does not appear in any of the others.

4. A set of dimensionless groups should be so made up that any other dimensionless group not in the set, but which can be made from secondary variables, will be a product of two or more groups in the set.

Dimensional Analysis Problems

Rather than illustrate the use of DA with a chemical engineering problem for which the answer is already known, we'll try a problem that is a little out of our line.

Example—What is the resisting force offered to the wing of an airplane? Assume that the resistance depends on shape, size, speed, density of air and viscosity.

Solution—We'll assume that shape will always be fixed in any particular case. The effect of shape can then be investigated independently by model experiments.

Now we can list the secondary quantities:

R = resisting force,	MLt^{-2}
= size,	L
V = speed,	Lt^{-1}
ρ = density,	ML^{-3}
μ = viscosity,	$ML^{-1}t^{-1}$

There are three primary quantities: M = mass, L = distance, and t = time. Then the number of dimensionless quantities required is five minus three.

Writing the equation with its units, and assigning a symbolic exponent to each unit,

$$f(l, V, \rho, \mu) = R$$

$$L^a\,(L/t)^b\,(M/L^3)^c\,(M/Lt)^d = (ML/t^2)^e$$

Since we want to solve for R, assign e the value of 1, for the first dimensionless quantity. It will be necessary to fix one other exponent since we have only three primary quantities to use for setting up simultaneous equations. The exponent zero will eliminate the quantity to which it is assigned. Let us assign zero to μ.

Now we set up simultaneous equations for the exponents based on each primary quantity in turn, multiplying each unknown exponent by the numerical exponent of the primary quantity shown in the representation of the secondary quantities.

Based on M $\quad c + d = e$, $e = 1$ and $d = 0$: $c = 1$

Based on L $\quad a + b - 3c = 1$

Based on t: $\quad -b = -2$

$a = 2 \qquad b = 2 \qquad c = 1$

$f(l^2, V^2, \rho) = R$ or, $f(l\ V^2\ \rho/R) = 0$

The dimensionless group $= l^2V^2\ \rho/R$

This can be checked by substituting units for each variable. To determine the second dimensionless group, we eliminate R by setting its exponent equal to zero. We also want to be certain to include μ in the group since it did not appear in the first group. Therefore assign it the exponent 1. Our simultaneous equations then become,

$e = 0 \qquad d = 1$

Based on M: $\quad c + 1 = 0$

Based on L : $\quad a - b - 3c - 1 = 0$

Based on t; $\quad -b - 1 = 0$

$a = 1 \qquad b = 1 \qquad c = -1$

$f(l^{-1}, V^{-1}, \rho^{-1}, \mu) = R^0$

$f(\mu/l\ V\ \rho) = 1$

The second dimensionless group $= \mu/l\ V\ \rho$

By Buckingham's theorem,

$$l^2\ V^2\ \rho/R = f(\mu/l\ V\ \rho)$$

$$R = [(l^2\ V^2\ \rho)]\,[f(l\ V\ \rho/\mu)]$$

which is the final equation. The function f is unknown. But the number of wind tunnel experiments required to find f is reduced to a minimum.

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Next step after Dimensional Analysis is the use of
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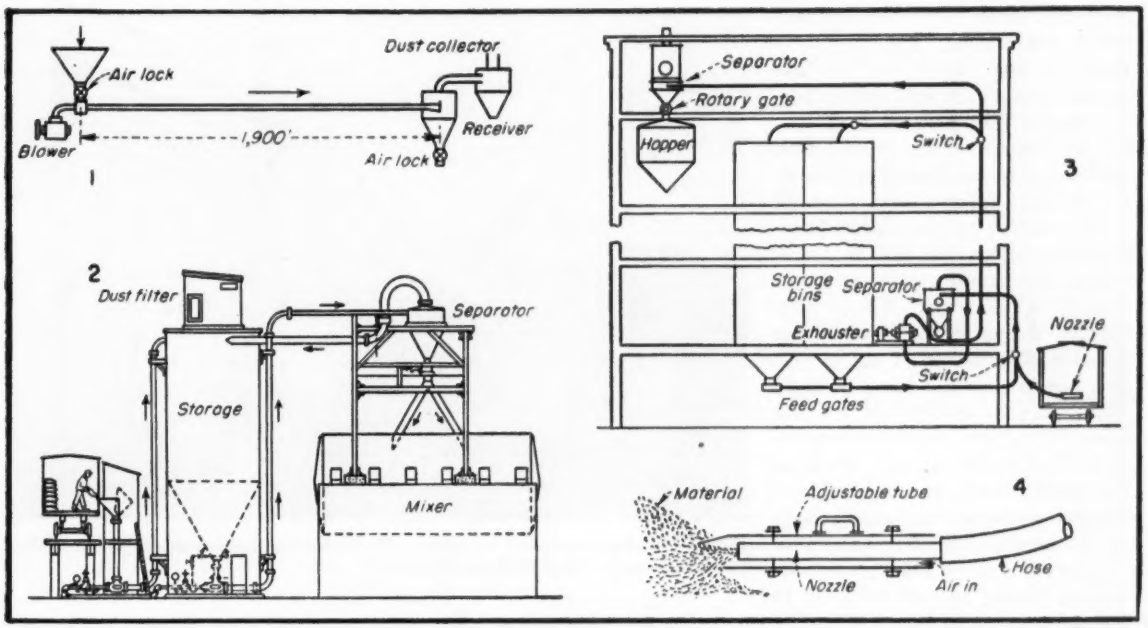

Figs. 1-4—(1) 1,900-ft. horizontal pneumatic conveyor illustrates numerical examples; (2) pneumatic system unloads, stores and charges slate particles to mixer without dust; (3) pneumatic system combining suction and pressure handling unloads, stores and reclaims soda ash without dust hazard; (4) simplest type of feed nozzle adjusts readily to different materials.

Why Use Pneumatic Conveyors?

Pneumatic conveyors are versatile, safe and convenient. They are dustless and often lower in capital cost than other types. Hence their higher power cost may be of secondary importance.

WILBUR G. HUDSON

Power requirements for pneumatic conveyors are far higher per ton per hour than any type of mechanical conveyor, but they can solve problems that no mechanical conveyor can touch. Many times the power needs are of secondary importance to the pneumatic conveyor's inherent advantages which include dustlessness, ability to follow any path, no matter how tortuous, and elimination of danger to operating personnel.

Furthermore, today we have a sound basis of empirical formulas for design, applying to a wide range of materials. Except when the purchaser fails to supply complete data on the characteristics of his material, disappointments are rare. Of course, 40 years ago when the pneumatic conveyor was first introduced for handling boiler house ash, we had a rather tough time. Since there was no mathematical or theoretical guide, we "guessed" at air volume and velocity, then put in a substantially larger exhauster than seemed necessary. We got along fairly well except for a few disasters, chiefly gas explosions in storage tanks or dust collectors.

Sometimes a pneumatic conveyor can be installed for far less cost than a mechanical conveyor. An example is shown in Fig. 1 which illustrates a conveyor for transporting fine salt horizontally over a distance of 1,900 ft. at 40 tons per hr. As a later mathematical analysis shows, the requirements are 170 hp. and 5,600 cfm. of free air at 5.25 psi., using a 12-in. pipe. A belt conveyor could do this job with 10 hp., or about 6 percent of the power, but it would require a housed conveyor with nearly 4,000 ft. of belt, 600 idlers, a supporting structure, and the drive. It would cost far more than a pipeline with a 200-hp. motor and blower.

The power is related directly to the characteristics of the material. If in this example the material had been light, pulverized cork, for example, the requirements would have been 42 hp., with 1,600 cfm. of air at 4.6 psi. through a 9-in. pipe.

Let us consider a few illustrative installations to show what this conveyor can do.

Fig. 2 shows the arrangement at a plant mixing pulverized slate with melted asphalt, which then is used for coating roofing paper. A large plant

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reservoir of air at 75 psi. was available, and so was utilized. The slate is received in bags which are cut and emptied into a duct fitted with a venturi nozzle. The pressure blast conveys the material to the storage tank from which the air drifts out through a cloth filter. When a batch is needed in the mixer, a second venturi blows the material from the tank to a centrifugal receiver whence it passes down through an airlock gate. The air filter consists of muslin panels which are automatically vibrated at the end of each run to clear the fabric. Arching in the tank is prevented by jets just above the outlet. A combination of feeders and bucket elevators would do this job but could not readily be made dustless, which here was an important factor because of adjacent operations.

Take Fig. 3 which shows an installation for moving soda ash from cars to service storage or to reserve storage, or from reserve storage to service storage. The operating scheme involves a combined suction and pressure system and is readily understood from the drawing. The important advantage of the pneumatic system here is the dustless unloading of this extremely irritating material from cars, as contrasted with the alternative power shovel. The fact that it requires 30 hp. as against 5 hp. for the shovel is of minor importance.

Getting the material into the pneumatic system sometimes is a problem. For flowable material there is a simple automatic feeding nozzle, Fig. 4. This double tube has the outer tube adjustable by trial to get the best rate of material inflow. Some materials, however, (e.g., cement, barium sulfate, pulverized phosphate rock and limestone) pack and will not flow into a nozzle of this type so a special feeder, Fig. 5, is employed. Beyond the air inlets a perforated disk rotates slowly to agitate the cement and feed it into a choke-feed screw driven by a built-in motor. At the discharge end of this screw air jets aerate the cement as it enters the conveying duct. The choke feed prevents backward air flow through the screw. Such units may be remotely controlled.

Fig. 5—Special remote-controlled pneumatic feeder for materials such as cement which pack and will not flow freely into nozzle. (Fuller Co.)

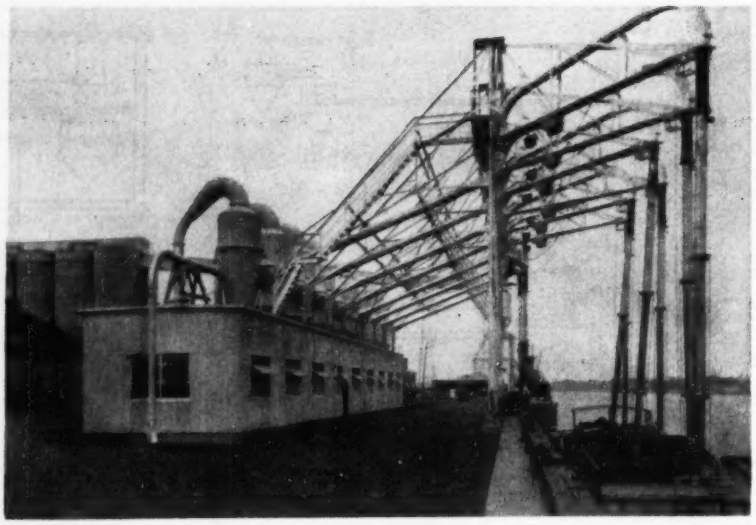


Fig. 6—Pneumatic unloaders at Albany, N. Y., remove grain from barges for further transport by rail. (Ingersoll-Rand Co.)

Fig. 6 shows a pneumatic grain elevator at Albany, N. Y. Six of the unloader units are working in the near barge and the other two in the barge to the rear. Each unloader is operated by twin centrifugal-type exhausters coupled to a single motor.

Centrifugal exhausters are constant-pressure, variable-volume machines. The limit for a single unit is about 2 psi. so two are in series to secure the 4 psi. suction here required.

With free-flowing granular materials the power requirement in such a layout is usually about 1.7 hp. per ton per hr. A bucket elevator would require about one-quarter the power, but this is more than off-set by the larger crew required when cleaning up, the danger to men in the hold shoveling into the elevator boot, and the more frequent shifting of the barge.

Fig. 7 shows a case where the pneumatic elevator provided the only practical solution. A plant is located directly above an anthracite coal seam some 800 feet below ground level. Originally, the coal, which belonged to the company, was mined under royalty and the small amount required for the plant was secured by truck from the tipple shaft about 1½ miles distant. Eventually the seam was worked out as a mining proposition, and the problem was how to get the plant coal supply to the boiler house.

A 12-in. well casing was sunk down to the gallery which was widened to accommodate a feeder, crusher and positive air blower. An 8-in. pipe was then led down through the well casing. Once each week two men took care of breaking out the required coal and feeding it to the crusher.

Practically all pneumatic systems are actuated by a mechanical compressor used either as an exhauster or blower. The exception is pneumatic ash handling systems. In these a steam-jet exhauster (Fig. 8) located between a centrifugal receiver and an air washer or dust separator, serves the dual function of vacuum producer and dust quencher. The power requirement is the steam equivalent of 75 hp. for a capacity of 300 lb. per minute. The steam valve is automatically shut at intervals to discharge the receiver. One important feature is that the conveyor duct serves as a ventilator, drawing in floating gas and dust, which is especially desirable when ashes are handled in a closed basement.

A recent application of one method of pneumatic conveying is shown in

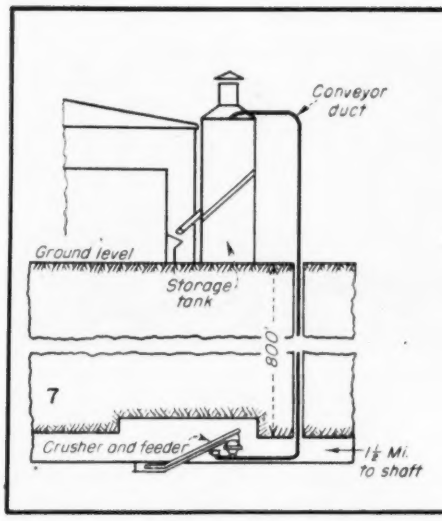


Fig. 7—Pneumatic elevator lifts coal 800 ft. from underground crusher to boilers.

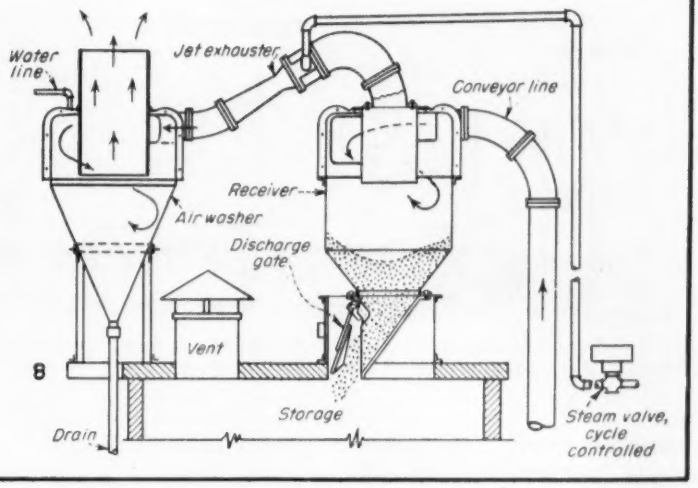


Fig. 8—In ash handling the vacuum producer is a steam jet exhauster, operated with a 10-sec. shut-off by cycle control to discharge receiver.

Fig. 9. This car, built by General American Transportation Corp., has far-reaching possibilities.

Shipments of pulverized food materials such as corn starch, milk powder and flour have formerly been bagged to protect them from vermin and bacteria. Bulk shipment has a decided advantage if all possibilities of contamination while loading, handling enroute and at destination can be eliminated.

The new "air-slide" car is roofed, provided with air-tight loading hatches and has a body divided longitudinally into two compartments with steeply sloped sides. Beneath each compartment is a pair of Fuller Air-Slide conveyors, consisting of 12-in. wide troughs with false bottoms of specially woven fabric, sloped at 15 deg. toward the mid-length of the car.

When the car is to be unloaded, air at a pressure of about 15 oz. is injected beneath the fabric and filters upward to aerate and fluidize the pulverized material. The lower ends of the gravity-flow troughs are connected to the suction line of the plant's pneumatic conveyor system and unloading takes place without possibility of contamination. With 300 cfm. of air at 15 oz., delivery of the material to the pneumatic unloader proceeds at about 1,000 cu. ft. per hr.

These cars are leased to shippers at about $300 per month. All maintenance is taken care of without charge to the user—who also enjoys the reduction in freight rates granted by the railroads to shippers furnishing cars.

Table I lists a number of materials that are handled in bulk in industry and shows which are suitable and which unsuitable for air conveying.

CONVEYOR CALCULATIONS

We noted in the early part of this article that a simple method is available for determining the air velocity and volume for pneumatic conveyors of the low-pressure type. The method is largely empirical since it depends on what we call the "specific weight" of the material. This specific weight is related to the "solid" weight (not bulk density) of the material, but it is increased more or less above the actual solid weight as the experience of the engineer determines. The method has been evolved from the actual data and analysis of more than 100 installations; it has proved to be quite accurate.

A simple formula which gives a close approximation of the volume flow rate of air required to move material is:

$$Q = WT \qquad (1)$$

where Q is the cu. ft. per min. of free air needed to move T tons per hr. of material of specific weight W. The velocity which this air stream must have depends on the average size and weight of the individual particles (small particles boost along the larger). Also the air must exert enough pressure to balance the particles in a vertical riser pipe, and must supply enough energy to convey the material usually at a velocity of about 50 fps. In a horizontal conveyor the air velocity may be less than in one having bends and risers.

From the series of tests mentioned

Table I—Suitability for Pneumatic Handling of Some Industrial Materials

(P indicates material is mildly corrosive. Y indicates material aerates and becomes fluid. Z indicates material packs under pressure and must be loosened up before it can be fed.)

Material	Bulk Density, Lb. per Cu. Ft.	Suitability
Alum, pulv.	45–50	Readily handled
Ashes, dry	35–40	Readily handled
Ashes, wet (P)	45–50	Packs in duct
Bauxite, crushed (Y)	75–85	O.K. moderate cap.
Bentonite, crushed	50	Readily handled
Borax, pulv.	55	Readily handled
Carborundum	100	Excessive abrasion
Cement (Y, Z)	75–85	Readily handled
Cement clinker	75–80	Mech. conv. better
Coal, anthracite		Readily handled†
Sized (P)	60	Readily handled†
Fines* (P)	60	Readily handled†
Coal, bituminous		Readily handled†
Fines* (P)	50	Readily handled†
Slack (P)	50	Readily handled†
Coke breeze	25–34	Readily handled
Copra cake	25–30	Sometimes sticky
Cottonseed, delinted	25	Readily handled
Cullet	80–120	Mechanical conv. better
Flaxseed	45	Readily handled
Fly ash, dry (Y)	35	Readily handled
Graphite, flake	40	Readily handled
Metal dusts,*	Various	Readily handled
Mica, pulv. (Y)	40	Readily handled
Phosphate, acid (Z)	65–70	Packs at bends
Plastic powders*	—	Readily handled, but risky dust
Pumice, ground	45	Readily handled
Salt, dry, fine	78–80	Readily handled
Salt, dry, coarse	45–50	Readily handled†
Sewage sludge	—	Cannot handle
Soap chips or flakes	15–25	Excessive degradation
Soda ash, light	20–35	Readily handled
Soda ash, heavy	55–65	Readily handled
Sugar, granulated	50–55	Degradation usually objectionable
Sulfur, lumpy	80–85	Handled readily but with some hazard from static sparks
Sulfur, powdered* (Y)	50–60	Handled readily but with some hazard from static sparks
Wood chips	20	Readily handled
Zinc oxide, light (Z)	10–15	Readily handled
Zinc oxide, heavy (Z)	30–35	Readily handled

* With materials whose dusts when mixed with air are explosive, there is the possibility that static sparks or sparks from impact of stray steel particles may cause detonation. Suitable pressure relief vents should be provided.

† If degradation is not objectionable.

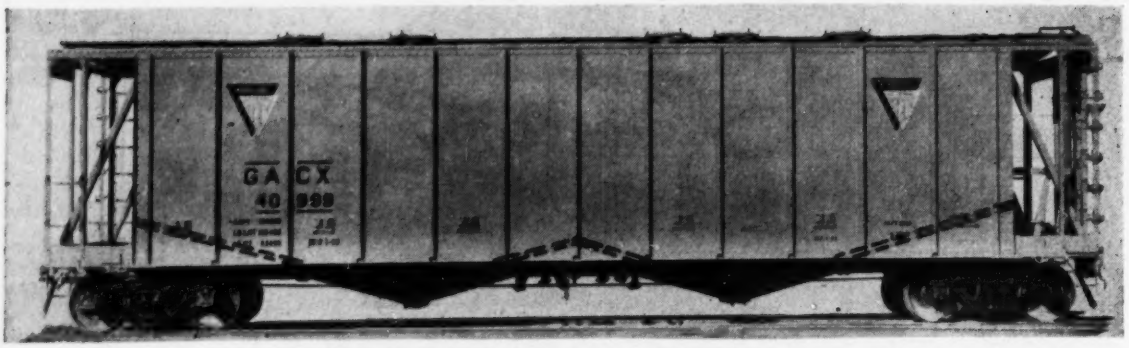


Fig. 9—Latest development in rail cars for bulk solids such as flour is the Air-Slide self-unloading car of General American Transportation Corp. Car is sealed to avoid all possible contamination. Note dotted lines which show position of Air Slides.

the velocities listed in Table II were adopted and later used satisfactorily.

Table III summarizes the equations needed in this method. After Q is found from Eq. (1) and V from Table II a suitable pipe size is chosen and then the total pressure loss for the air alone is found with the first six steps of Table III. Pressure losses due to the material are found from the next steps of Table III on the assumption that the material moves at 80 percent of the air velocity and attains this velocity in 1 sec. by the pick-up velocity of the air in the nozzle and hose in case of a pneumatic unloader. Speed in the nozzle V_1 is 1.6 V, and speed of material at the end of the hose is $V_1/2 = 0.80V$.

From the last two expressions in Table III the blower size is determined.

The procedure outlined in Table III will now be applied to the problem illustrated in Fig. 1 to derive the power requirements already given for fine salt and pulverized cork:

Salt:

Weight = 80 lb./cu. ft.
Specific weight W = 136 lb./cu. ft.
Q (Eq. 1) = 136 × 40 = 5,440 cfm.
V (Table II) = $10\sqrt{136}$ + 6 percent = 124 (ca it 120) fps.
Pipe size: try 12 in. diameter.
Then for V = 120, Q = 5,650 cfm.
Use Q = 5,650 and V = 120.

From Table III:

(a) = 5(120/100)² = 7 oz.
(c) = (120/100)² × (1,900/100) × 1.93 = 53 oz.
(d) = 4 × 2 = 8 oz.
(e) = 3 oz.
(A) = a + c + d + e = 71 oz.
(f) = 40 × (120)³/100,000 = 6 hp.
(h) = (40/1,000) × (1,900/5) = 16 hp.
(m) = f + h = 22 hp.
(M) = (22 × 3,200)/5,650 = 13 oz.
(P) = (71 + 13)/16 = 5.25 psi.
(q) = (5,650 × 5.25)/175 = 170 hp.

Cork dust:

Weight = 5 − 10 lb./cu. ft.
Specific weight W = 37.5 lb./cu. ft.
Q (Eq. 1) = 37.5 × 40 = 1,500 cfm.
V (Table II) = $10\sqrt{37.5}$ − 3 percent = 60 fps.
Pipe size: try 9 in. diameter.
Then for V = 60, Q = 1,600 cfm.
Use Q = 1,600 and V = 60.

From Table III:

(a) = 5(60/100)² = 2 oz.
(c) = (60/100)² × (1,900/100) × 2.77 = 19 oz.
(d) = 4 × 2 = 8 oz.
(e) = 3 oz.
(A) = a + c + d + e = 32 oz.
(f) = 40 × (60)³/100,000 × 3 = 4.5 hp
(Here assume that fine cork comes up to speed in half the time, hence is multiplied by 3.)
(h) = (40/1,000) × (1,900/5) = 16 hp.
(m) = f + h = 20.5 hp.
(M) = (20.5 × 3,200)/1,600 = 41 oz.
(P) = (32 + 41)/16 = 4.6 psi.
(q) = (1,600 × 4.6)/175 = 42 hp.

In the calculations just given items (q) are the power requirements mentioned in the opening paragraphs.

Referring again to Fig. 7, the installation for conveying coal upward from mine to surface, the theoretical figure calculated by this method for 15 tons per hr. was 50 hp. A test when the conveyor was put into service showed 60 hp. It is certain that the actual figure decreased as the bore became polished with use. Also, this total included a rotary gate feeder which consumed 1 hp. or thereabouts.

NOMENCLATURE

- A Total pressure drop for air movement alone, oz./sq. in
- c Blast efficiency (average 80 percent).
- H Lift, ft.
- l Average particle diameter, inches.
- L Length of run (line or hose), ft.
- M Total pressure drop for material movement alone, oz./sq. in.
- Q Air flow rate needed to move material, cfm. free air.
- P Total pressure drop to move air and material, psi.
- T Tons of material handled per hour.
- V Air velocity in line, fps.
- V_1 Air velocity in hose, fps.
- W "Specific weight" of material = "solid" weight increased as experience requires.

Table II—Velocities in Ft./Sec. in Pneumatic Conveying

Conveyor Type	Material Characteristics	Balancing Velocity	Line Velocity*	Hose Velocity*
Straight, horizontal runs	Dusty	$5\sqrt{Wl/c}$	$10\sqrt{W}$	$16\sqrt{W}$
	Grains	$6\sqrt{Wl/c}$	$12\sqrt{W}$	$20\sqrt{W}$
	Uneven, gritty	$7.5\sqrt{Wl/c}$	$15\sqrt{W}$	$24\sqrt{W}$
Runs with risers and ells	Dusty	$10\sqrt{Wl/c}$	$12.5\sqrt{W}$	$20\sqrt{W}$
	Grains	$12\sqrt{Wl/c}$	$15\sqrt{W}$	$24\sqrt{W}$
	Uneven, gritty	$15\sqrt{W/c}$	$18.75\sqrt{W}$	$30\sqrt{W}$

* Plus or minus 6 percent.

Table III—Pressure Losses for Air and Material

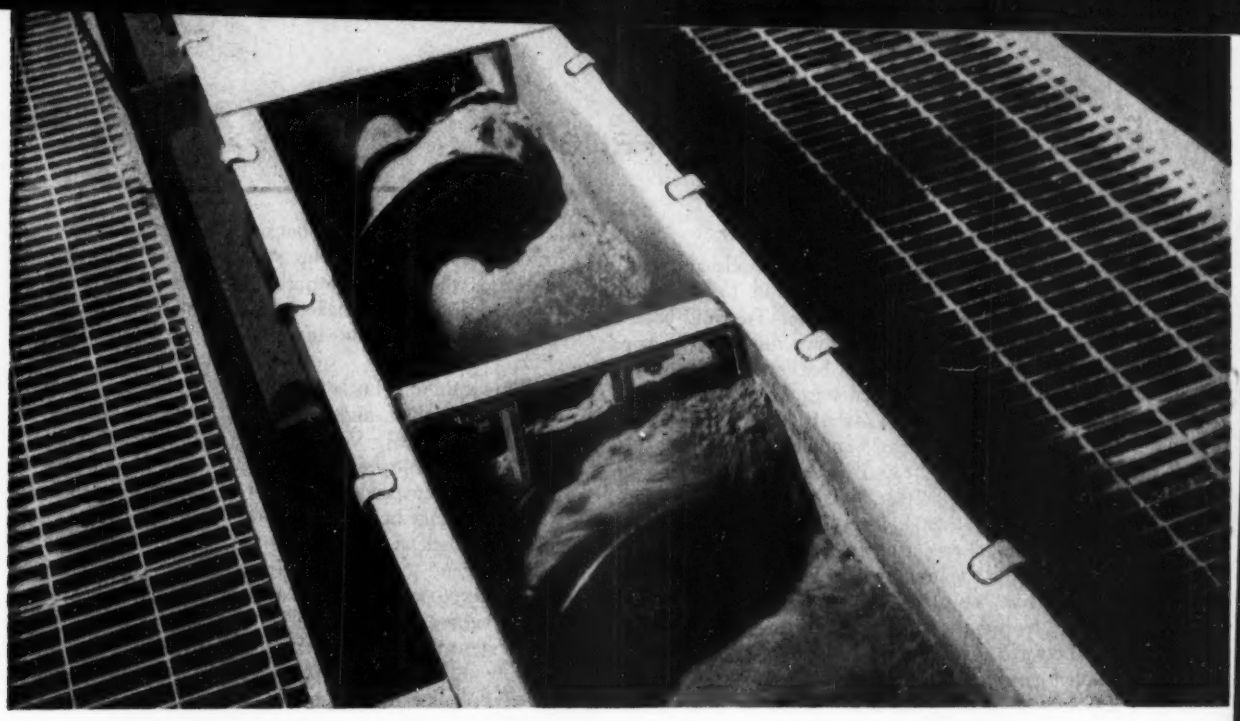
Losses due to air movement alone (oz./sq. in.)

(a) Loss at entrance (orifice) = $(V/100)^2 \times 5$
(b) Loss in hose = $(V_1/100)^2 \times L/100$ (where L is usually 35)
(c) Loss in line = $(V/100)^2 \times L/100 \times K$*
(d) Receiver loss = 4 oz. on average.
(e) Loss in connection between receiver and exhauster, or receiver and collector = 3 oz. on average.
(A) Total losses due to air movement = a + b + c + d + e (omitting items which do not apply).

Losses due to material movement alone (in horsepower)

(f) Loss due to inertia = $MV^2/2g \times 550 = TV^2/100{,}000$
(g) Loss in hose = (f)/2 (assumed) = $TV^2/200{,}000$
(h) Loss in line = $(T/1{,}000)(H + L/5)$ where H is lift in ft., if any.
(k) Loss in each 90-deg. elbow = $TV^2/200{,}000$
(m) Total loss for material, as horsepower = f + g + h + k
(M) Total loss for material, as pressure drop = 3,200 × (m)/Q oz./sq. in.
(n) Total pressure loss for air and material = A + M oz./sq. in.
(P) Total pressure loss for air and material = (A + M)/16 psi.
(q) Horsepower for blowing system = QP/175 hp.
(r) Horsepower for suction system = (QP/175)[(14.7 + P)/14.7)] hp.

* K is pressure loss in oz./sq. in. in 100 ft. length of pipe of given diameter, at 100 fps. velocity, as determined by Unwin. For several diameters its values are: 4 in., 8.5; 5 in., 6.25; 6 in., 4.8; 7 in., 3.95; 8 in., 3.25; 9 in., 2.77; 10 in., 2.43; 11 in., 2.14; 12 in., 1.93.



This report will save you time if you have a problem of moving bulk materials continuously. It will define the various factors involved, and aid you in resolving these factors to arrive at a satisfactory selection.

Conveyors & Elevators

CONVEYORS

1. Belt
   - a. Troughed
   - b. Flat
2. Screw
   - a. Helicoid
   - b. Sectional
   - c. Ribbon
   - d. Cut flight
   - e. Mixing flight
3. Apron
   - a. Overlapping steel pans
   - b. Hinged steel pans
4. Scraper or chain and flight
   - a. Single strand of chain
   - b. Double strand of chain
5. Oscillating or vibrating
   - a. Mechanical
   - b. Electrical
6. Mass flow
7. Chain drag

ELEVATORS

1. Bucket type
   - a. Centrifugal discharge or spaced bucket on either chain or belt
   - b. Continuous bucket—slow speed—on either chain or belt
   - c. Positive discharge—medium speed—on chain
   - d. Gravity discharge
   - e. Pivoted bucket
2. Mass flow type
   - a. Solid flight
   - b. Redler flight
   - c. Tubular scraper
   - d. Tubular zipper
3. Screw or rotor-lift
4. Inclined belt conveyor
5. Inclined scraper or flight conveyor
6. Inclined apron conveyor

CHEMICAL ENGINEERING REPORT—APRIL 1954

HARRY L. STRUBE

THIS report on conveyors and elevators does essentially two things: (1) describes the salient features of the various common types of equipment for handling bulk materials continuously such as those frequently encountered in chemical processing, and (2) provides aids for selection of the proper type of equipment for a given continuous bulk handling job.

HARRY L. STRUBE, *materials handling engineer of Philadelphia, Pa., has had many years experience and is well known in the field.*

Table VIII, p. 209, will be of particular help in selection. This table relates the suitability of various types of conveying and elevating equipment to critical material characteristics. Table IX further aids selection by listing these critical characteristics for a number of common materials.

Value of this report lies largely in the fact that the reader will be in a position to make an intelligent evaluation of the answers to his particular problem that he will receive from the various manufacturers. He will not have to wade through a stack of catalogs to define his problem and arrive at a reasonably good solution to it.

Equipment Types Are Varied

Centrifugal Discharge Bucket Elevator

As the name implies, material to be elevated in the centrifugal discharge bucket elevator (Fig. 1) is discharged from the buckets by centrifugal force. To avoid back legging (return of material on the down run), there is a relationship between speed of the buckets and diameter of the head wheel to be followed regardless of capacity.

Range in speed, for most materials handled and for the various sizes, lies between 225 and about 300 fpm. Wheel diameter is between 20 and 31 in. Bucket sizes range between 6 × 4-in. and 16 × 8-in., and capacities of 100 lb. per cu. ft. material range from 14 to 152 tons per hour. However—for grain, cottonseed, wood chips and certain other light weight materials—the double leg casing elevator having buckets mounted on a belt and travelling at higher speeds is frequently used. Bucket speeds of such units range between 350 and 750 fpm. and the head wheel diameters range from 24 to 72 in.

Buckets are spaced on either chain or belt. Distance between buckets can vary between 16 and 24 in. depending upon the capacity desired. Boot section is made with a curved bottom plate to aid the buckets in picking up their load. To take up the slack in the chain or belt, take-up bearings are used which may be located either at the top or the bottom as operating conditions prescribe. (Special counterweighted take-ups can be applied in place of the usual hand screws for conditions causing unusual stretch.)

Centrifugal discharge elevators should not be used for materials containing over 10-15 percent lumps because of the opportunities for jams in the boot and the difficulty in retaining lumps in the buckets as they travel upwards. If breakage of the material is to be avoided, the centrifugal discharge elevator should not be specified. Usually the elevator is enclosed in a steel casing to provide a means for supporting it and as a matter of safety and dust detention. These casings are regularly made with inspection and clean-out doors. Explosion doors may be installed.

Choice between chain and belt as an elevating medium depends upon the characteristics of the material handled. For instance fine, highly abrasive products cause less wear on a rubber covered belt than on a metal chain with its multiplicity of articulations. Where the temperature of the belt is likely to exceed about 200 deg. F., it is safer to use chain and select the best quality obtainable for the service. (There are some higher-temperature belts now on the market which may be used under certain conditions.)

Where the material contains hard sharp lumps, there is a tendency for these lumps to become lodged between the buckets and belt resulting in damage to the belt as it passes over the head pulley. In this case, chain is a better selection. For handling non-abrasive or semi-abrasive materials, it is best to examine the relative cost of the two mediums, giving due consideration to the life factor. With this type of equipment the cheapest first cost frequently becomes the more expensive in the long run.

Continuous Bucket Elevator

In the continuous bucket elevator (Fig. 2), buckets closely spaced on chain or belt are designed so that material is loaded directly into the buckets through a loading leg, instead of being scooped up in the boot. Discharge over the head wheel is accomplished by transfer of material from the discharging bucket to the front of the preceding one which acts as a moving chute to the fixed discharge chute.

The continuous bucket elevator on chain is preferably a slow speed affair, and ordinarily should not exceed 125 fpm. bucket speed. Where highly abrasive materials are handled, reduced speeds are advisable. When mounted on belts the bucket speed may be increased, and when inclined the elevator may be operated up to about 200 fpm. When selecting a belt as an elevating medium—materials which pack and tend to build up between the belt and pulley as well as jagged particles which damage the belt by becoming lodged between buckets and belt—should be avoided. To some extent these difficulties are alleviated through the use of wing pulleys on the foot shaft. Temperatures above 200 deg. F. are not conducive to long belt life. In this case belts should be avoided in favor of chains.

Continuous bucket elevators are especially well adapted where degradation of the material is to be minimized, and where extreme dust conditions are to be avoided as far as is possible. Because of the method of loading, they will handle lumpy material whereas the centrifugal discharge elevator will not. Receiving point of the continuous type is somewhat higher than that of the centrifugal, necessitating a deeper pit when located below ground level.

Large-capacity (super-capacity) elevators are made with specially designed steel buckets attached at their ends to double-strand long-pitch steel chain.

Self supporting steel casings are usually used on vertical continuous buckets elevators with take-up bearings at either top or bottom as conditions require.

Bucket sizes vary from 8 × 5-in. to 18 × 8-in. Capacities of 100 lb. per cu. ft. material vary from 34 to 117 tons per hour at 125 fpm. Super-capacity buckets are made up to 36 × 16-in. in size.

Positive Discharge Bucket Elevator

Where materials tend to stick in the buckets or where fluffy materials are handled, the positive discharge bucket elevator (Fig. 3) should be considered.

With its buckets spaced at intervals on double strand chain, this elevator picks up its load in the boot (as does the centrifugal discharge type)—but because of its lower speed does not depend upon centrifugal force to discharge material from the buckets. The buckets are completely inverted by snubbing the chains after they have passed over the head wheels, giving them opportunity for complete discharge at relatively slow speed.

Since the positive discharge bucket elevator is a low capacity unit for the cost involved, it does not replace the centrifugal discharge or continuous bucket elevators where they are applicable. However, it will solve some difficult handling problems where the others will not.

Bucket spacing is 20 to 24 in. depending upon size of buckets. Chain speed is about 120 fpm. Bucket sizes vary from 8 × 5-in. up to and including 24 × 8-in. Corre-

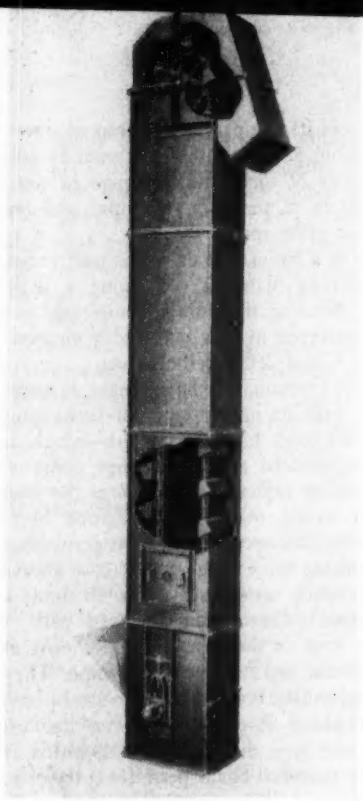


Fig. 1—Centrifugal discharge

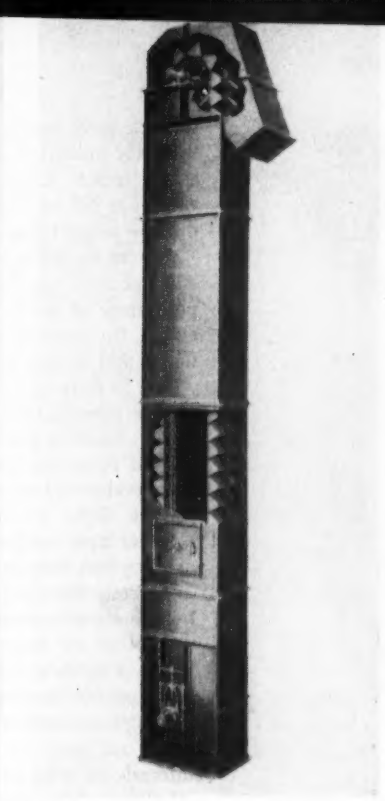


Fig. 2—Continuous

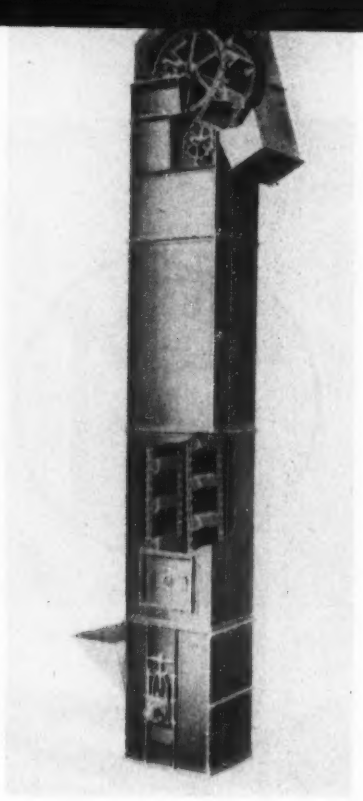


Fig. 3—Positive discharge

sponding capacities of material weighing 100 lb. per cu. ft. vary from 11 to 69 tons per hour.

A unique modification to this type uses a single strand of chain with buckets placed on both sides of the chain rather than centrally, thus permitting the snub wheel to engage the chain after passing the head wheel.

Pivoted Bucket Carrier

The pivoted bucket carrier (Fig. 4) receives its name from the method of suspending the carrying bucket from double-strand long-pitch chains. Buckets are always in a load-carrying position whether path of travel is vertical, horizontal or inclined. Discharge is effected by trippers engaging cams located on the bucket ends. This is done in such a manner as to up-end the buckets sufficiently to completely empty them. Buckets can receive their loads anywhere along the horizontal lower run of conveyor, and discharge can take place anywhere along the upper horizontal run depending upon whether the tripper is of the fixed or the travelling type.

While this type of equipment is probably the costliest of any due to its design and refinement of manufacture, it will accomplish results not attainable by other types because of its ability to both elevate and convey such materials as coal, ash, coke, ore, clinker, crusher stone and others both abrasive or non-abrasive, hot or cold. Speed of travel is slow, seldom over 80 fpm. Horsepower requirements are low. Buckets are made of malleable iron, steel or a combination of both depending upon the nature of the load. Chains are made of either malleable iron or forged steel links with case hardened pins and bushings, and generous-size single-flanged rollers at articulations.

En Masse Conveyors and Elevators

The en masse unit is a relatively new type which carries materials en-masse through a dust and weather-tight enclosure completely filling its cross-section. The conveyor medium is an endless chain upon which are mounted flights at suitable intervals. Flights are made either of the solid or the open-finger types. They are self-feeding and discharge through an aperture in a manner depending upon the design of the manufacturer. This elevator is well adapted to handle granular or pulverized free-flowing materials which are not abrasive or corrosive. Intimate contact between material and casing thus limits application.

This unit is quite flexible in its application and takes

Table I—Bucket Characteristics, Pivoted Bucket Carrier

Size of Bucket, In. Pitch	Width	Capacity, Cu. Ft. per Hr.	Recommended Max. Speed, Fpm.
18	15	800	40
18	18	1,000	40
18	21	1,200	40
24	18	1,800	50
24	24	2,400	50
24	30	3,000	50
30	24	4,200	60
30	30	5,200	60
30	36	6,200	60
36	36	10,200	80

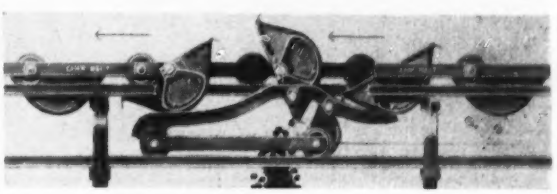


Fig. 4—Pivoted bucket carrier

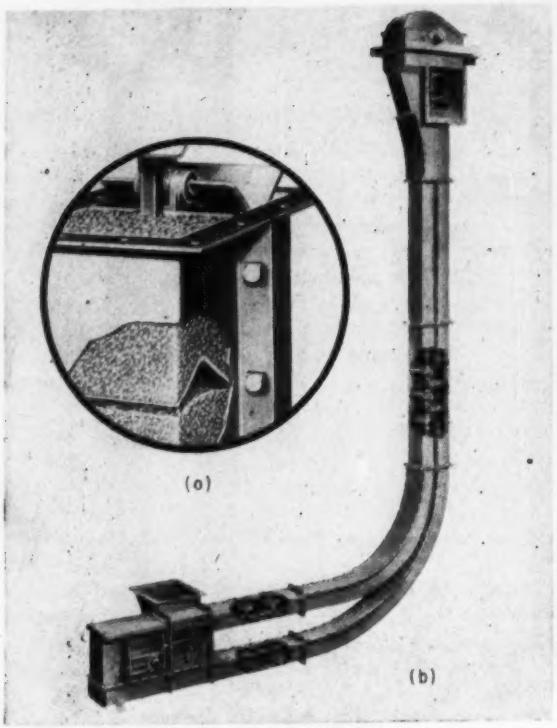


Fig. 5—En masse unit. Solid rectangular flights.

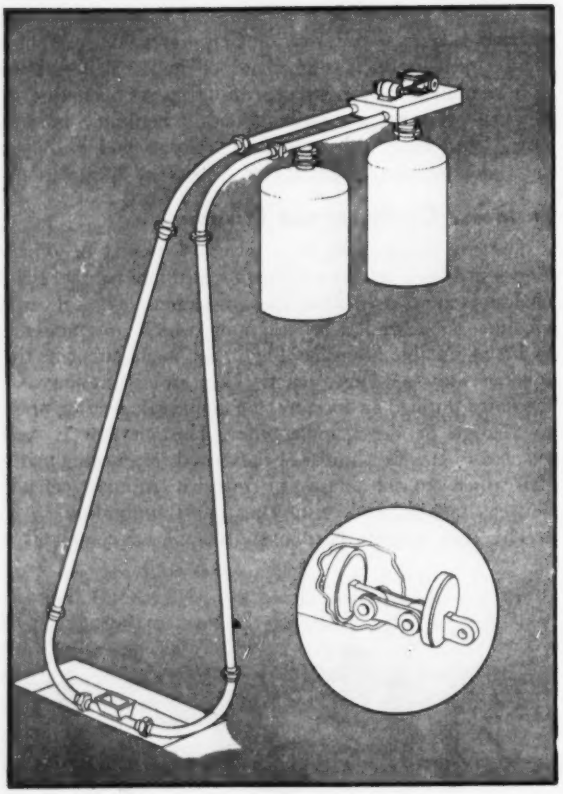


Fig. 6—En masse unit. Circular flights.

up little space because of its compactness. Speed of travel is usually limited to about 80 fpm. although slower speeds are preferred. Capacities of the complete range of sizes vary from 300 to 2,000 cu. ft. per hour at 50 fpm. and are directly proportional at other speeds.

Where degradation is a factor, the en masse unit is not well adapted for handling materials containing a large percentage of lumps. Because the unit is completely enclosed, the material conveyed in it is not readily contaminable and neither is it completely self-cleaning.

Fig. 5a shows the solid rectangular shaped flight as made by one manufacturer with its peaked-top, self-discharging flight. Another manufacturer hinges its flight—which is tripped by a cam arrangement at the discharge point of the elevator—to an incline sufficient to discharge the load on the flight which would otherwise be carried over. Another type, the Redler, has open-finger flights permitting no carry-over but requiring the vertical casing to be always completely filled to properly mass-convey. Fig. 5b shows a typical elevator-conveyor following an L-shaped path.

Another en masse type is the tubular type shown in Fig. 6. Flights are circular and run in ordinary pipe. They are usually of synthetic rubber bonded between steel plates although sometimes plastic-fibre, cast iron or stainless flights are used. In one type the flights are mounted at intervals on a flexible universal chain permitting travel in all planes. In another, steel cable is used instead of chain, and the cable is covered throughout its length by the extended hubs of the flights which are thus interlocked.

Still another type of en masse conveyor is known as the "zipper." See Figs. 7 and 8. A specially-constructed flat, endless rubber belt with two wing belts attached thereto is designed to fold up to a semi-circular encloseure about 4 in. across. The outer edges of the wings are made with rubber "zipper" teeth which interlock when closed. Special devices for locking and unlocking the zipper teeth are provided and when empty it operates as a flat belt conveyor. On horizontal or inclined runs, the material can be discharged over the head pulley; on vertical runs it can be discharged at the top of same; on horizontal runs it can be made to discharge at fixed intermediate points, or by a travelling discharger will spread discharge horizontally.

This conveyor will operate at speeds up to 200 fpm. at which speed it will deliver about 14 cfm. It will handle dry chemicals (granular, flaky, pulverized or lumpy) up to 1½ in. without degradation, segregation or contamination. It is dust tight. It lends itself to various paths of travel and occupies little space.

Drag Conveyors

The simple conveyor illustrated (Fig. 9) consists of a special cast-steel, wide-link pintle-type chain having broad wearing surfaces which drag over a trough. This trough can be made of ordinary steel plate if the material handled is non-abrasive, or of hard iron if abrasion is a factor. Sometimes the trough is constructed of concrete when built into the floor of a building.

It is specially designed to handle hot, abrasive materials such as cement clinker, but can be adapted to chemicals having similar characteristics. For non-abrasive materials having characteristics similar to sawdust or the like, the cost of drag conveyors can be reduced by using standard wide-link malleable-iron chain.

Capacity of these conveyors does not often exceed 20 tons per hour of material weighing 50 lb. per cu. ft., and the travel speed should not exceed about 25 to 30 fpm. Materials containing about 10 percent lumps can be handled—but the maximum lump size will depend upon the clear openings in the chain link through which the material passes when discharging from the lower run of the conveyor.

There are other modifications of chain design applicable to this type of conveyor which perform in a similar manner. For the severity of the service they are called upon to withstand, they are remarkably free from maintenance while having good accessibility for repairs.

Flight Conveyor

Flight conveyors drag materials along in steel troughs at speeds up to 100 fpm. They are usually limited to materials of non-abrasive nature. They can be made to run horizontally or at inclines up to 45 deg. or a combination of both horizontal and incline.

A single-strand type has flight sizes from 10 × 4-in. up to 18 × 6 in. with corresponding capacity of 930 to 2,500 cu. ft. per hour at 100 fpm. conveyor speed and 24 in. spacing of flights.

A double-strand has flight sizes from 16 × 8-in. up to 36 × 12-in. with corresponding capacities from 3,200 to 11,500 cu ft. per hour at 100 fpm. conveyor speed and spacing of flights from 24 to 36 in.

The single-strand unit will handle lump sizes up to 5 in. while the double-strand will take up to 16 in. on the largest flight size.

The single-strand type usually has a malleable iron pintle chain while the double strand usually has the long-pitch steel bar-link roller-chains for heavy duty.

The flight conveyor lends itself to a wide variation of flight sizes and chain types which can be designed to meet particular service conditions.

Ordinarily flight conveyors do not require enclosures although they can be furnished to suit conditions.

Gravity Discharge Elevator-Conveyor

The gravity discharge elevator-conveyor (Figs. 10, 11) elevates and conveys materials of a non-abrasive, free-flowing nature. Operating vertically or on a steep incline it functions as a bucket elevator and horizontally as a scraper flight conveyor. Steel buckets rigidly attached to double-strand steel bar-link, long-pitch roller chain, travel along a continuous steel trough on the horizontal loading run, picking up the material enroute. At the lower corner upturn a special steel corner trough is used to fill the buckets before starting their vertical run. At the upper corner another curved corner piece is provided to transfer the load to the upper horizontal run from where it can be discharged at intervals through openings provided with slide gates. The discharge angle of the bucket is steep enough to empty it as it passes over the discharge opening.

Capacities of this type of equipment are from about 1,400 to 4,800 cu. ft. per hour, at 100 fpm. Since the bucket sizes vary from 16 to 36-in., the gravity discharge elevator-conveyor is capable of handling large lumps. It is especially well adapted to handle coal or material having similar characteristics.

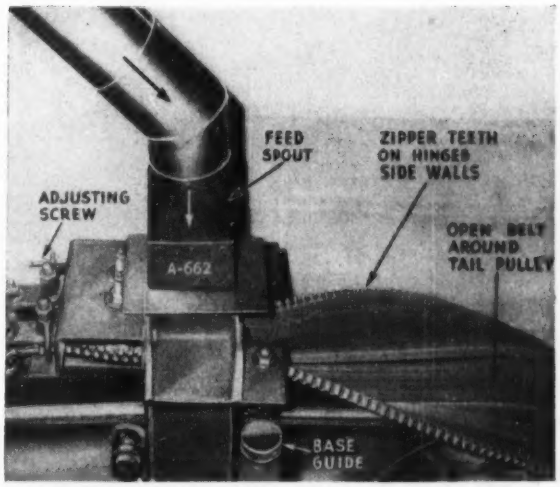


Fig. 7—En masse unit. Zipper type.

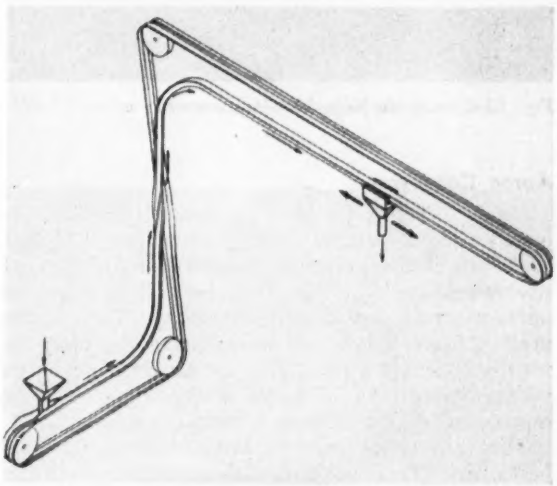


Fig. 8—En masse unit. Zipper installation.

Fig. 9—Drag conveyor.

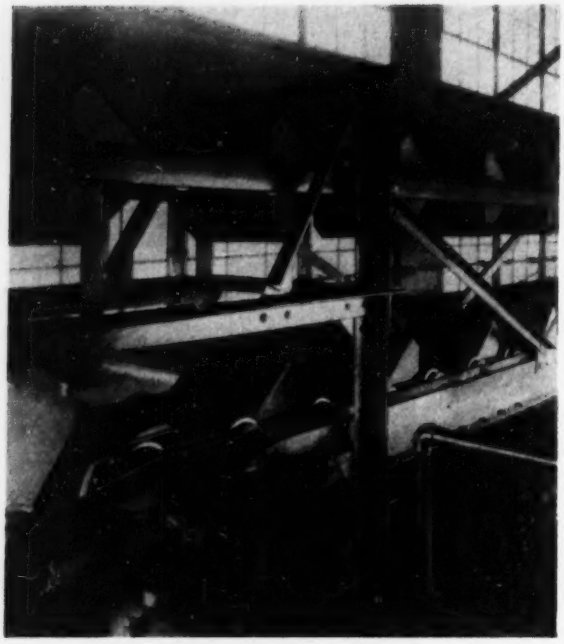


Fig. 10—Gravity discharge elevator-conveyor

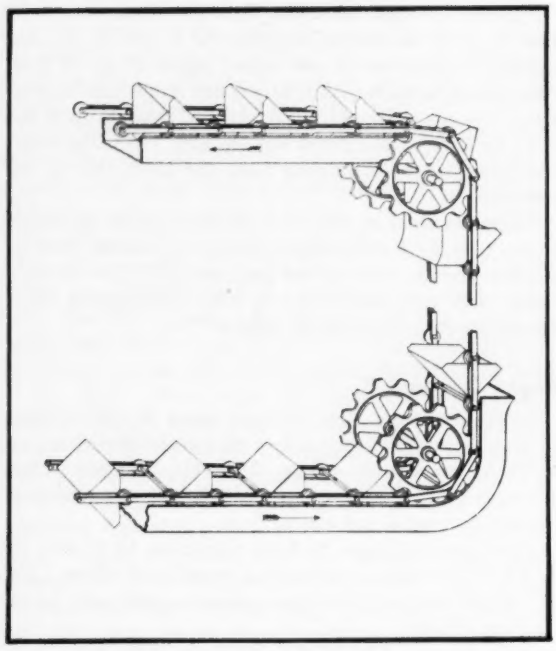


Fig. 11—Gravity discharge elevator-conveyor

Apron Conveyors

Apron conveyors for handling materials in bulk are usually made of metal pans, either overlapping or hinged at the articulation points, and mounted on double-strand steel roller-chain. They operate horizontally or at inclines up to about 30 deg. from the horizontal. They can be made in heavy or light-duty designs depending upon the severity of service required, and are usually made up on widths varying from 12 to 60 in. depending upon the capacity and the size of lumps in the material handled.

They can be designed to handle light materials or heavy ores. They are particularly applicable as feeders where they withdraw materials from hoppers or bins. In this application, they are generally provided with stationary side plates for increasing capacities and adapting them to large lumpy materials. Their operating speeds as feeders are slow, not much over 10 fpm., but as conveyors they can run safely up to 100 fpm.

The "no leak" type is well suited to handle materials with small particles sizes since the side plates are made part of the pans and special attention is paid to obtaining an overlap having the closest clearance possible to prevent leakage. The "no-leak" apron is designed to withstand the wear of abrasive materials, the chains being located under the pans to avoid direct fall of material on them. Carrying rollers are located outboard on the cross rods for easy accessibility for repairs. Fig. 12 (top) shows the double beaded type used on the no leak aprons and on light service conveyors where short-pitch, cheaper chains may be used.

Fig. 12 shows cross-sections through typical overlapping pans of which there are numerous variations. Fig. 13 shows an installation of this type. Fig. 14 shows a hinged apron pan used for relatively light service where a smooth joint and minimum opening is desired.

Fig. 15 shows a heavy duty apron for heavy ores and large lumps, capable of absorbing shock loads. The pans are made of cast manganese of heavy thickness. Manganese chains located under the pans for protection are carried on rollers as shown. They are well adapted as feeders on heavy ores where the service is especially severe.

Belt Conveyors

A standard belt conveyor consists of a rubber or canvas belt made endless by lacers or by vulcanizing. It is carried on rollers turning on anti-friction bearings and two terminal pulleys, one of which drives the belt and the other provides a means for taking up the slack which accumulates as the belt stretches.

The roller assemblies are familiarly known as "idlers" which can be either made of the flat or the trough type. For larger capacities, the carrying belt of the conveyor is normally supported on the troughing idler and the return belt on flat idlers. Flat belts are discharged either over the terminal pulley or at intermediate points by means of plows placed diagonally across the belt. Troughing belts can be made to discharge along intermediate points by a traveling tripper.

Capacity of flat belts handling bulk materials is of necessity limited, as is the nature of materials it will successfully handle. When plows are used, travel speed of the belts is seldom more than 150 fpm. However, with troughing belt conveyors the speeds and capacities are much greater, as seen in the capacity chart in Table II.

Other considerations concerning good belt conveyor practice are given in Tables III, IV, and V.

When loading belt conveyors, spill is avoided by providing stationary side skirts for a short distance. These side members are set in from the edges of the belt about 3 in., and are fitted with rubber strips along the bottom edges

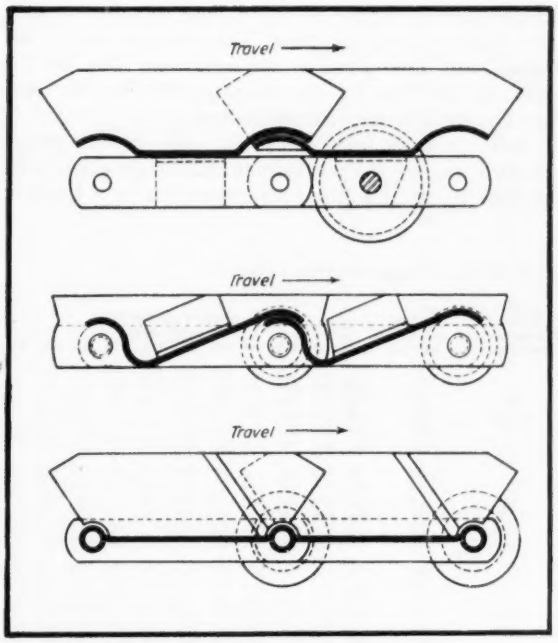


Fig. 12—Apron conveyors; typical overlapping pans.

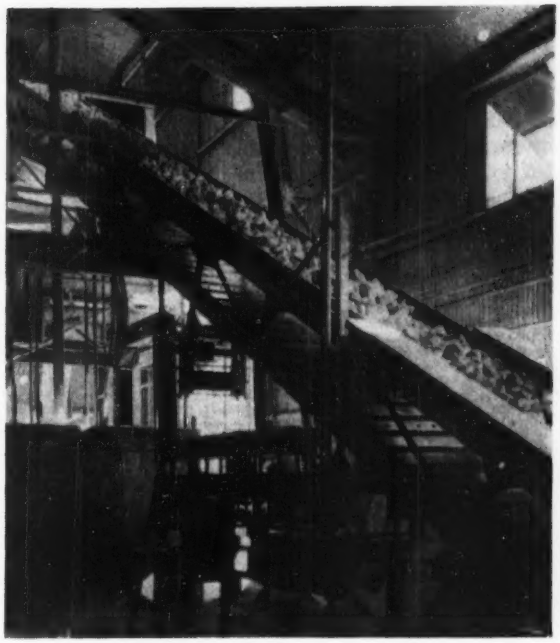


Fig. 13—Apron conveyor with overlapping pans.

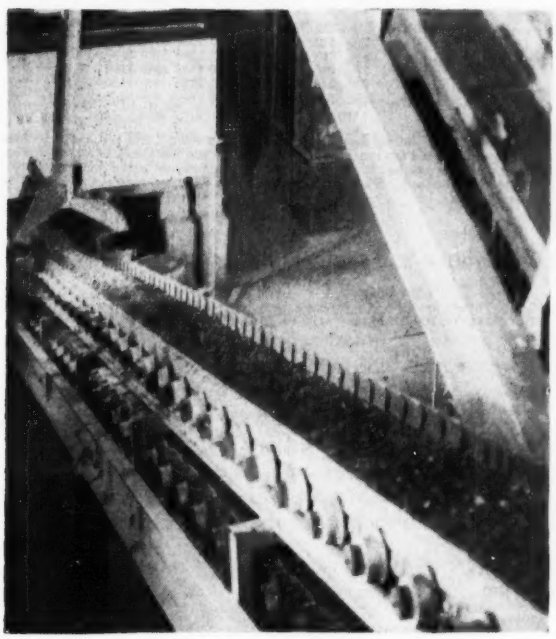


Fig. 14—Apron conveyor with hinged pans.

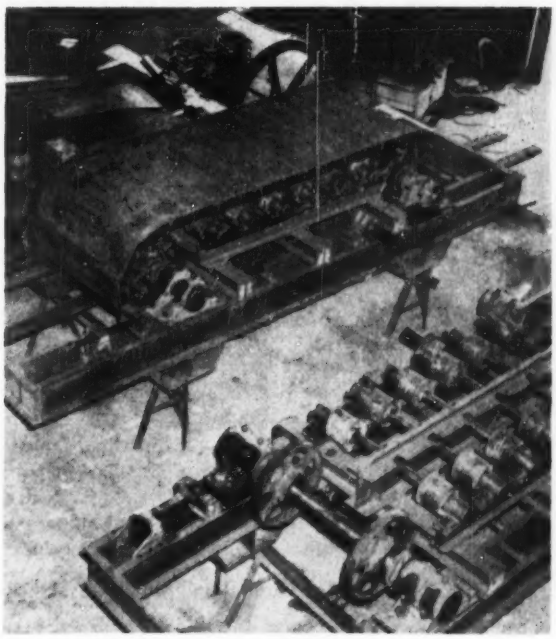


Fig. 15—Apron conveyor for heavy duty.

to prevent injury to the main belt. Distance between the skirts determines the maximum lump size which can be loaded upon the belt of given width without danger of bridging or clogging the feed chute. Materials should be discharged in the same direction a belt is running, and at as near its speed as possible to avoid cover-abrasion.

For handling bulk materials, conveyor belts are made up of canvas plies which are rubber covered on both sides—the carrying side made heavier to withstand the wear of the material and the lighter return side for taking the wear of pulley and idler contacts. See manufacturers' literature for belt conveyor and belt design calculations.

While belt conveyor parts such as idlers, pulleys, drives, and frames have been very well standardized, a complete installation (particularly if it is a large one) must be engineered because of the variations possible in length, capacity and incline. This refers especially to the selection of the belt itself. In case of doubt, selection should be left to the manufacturers. To obtain maximum belt life, caution should be exercised in the choice of the best combination of weight of canvas duck, number of plies, and thickness of rubber cover. This is to take care of the figured belt tension and at the same time allow for the necessary flexibility for easy troughing over the idlers and good action over the terminal pulleys.

Belt conveyors less than 14 in. wide do not trough properly and are difficult to train. Discharge along intermediate points of a troughing conveyor is by a traveling

Table II—Belt Speeds and Capacities for Various Weights of Materials and Widths of Belts

Belt Width, In. (Cross-sect. of Load, Sq. Ft.)	Weight per Cu. Ft. of Mat.	Capacity, Tons Per Hr.—Belt Speed—Fpm. 100	150	200	250	300	350	400	450	500	550	600
14 (0.108)	30	9	14	19	24	28	—	—	—	—	—	—
	50	16	24	32	40	47	—	—	—	—	—	—
	75	24	35	47	60	71	—	—	—	—	—	—
	100	32	47	63	79	95	—	—	—	—	—	—
	125	40	60	80	100	120	—	—	—	—	—	—
	150	47	71	95	120	140	—	—	—	—	—	—
16 (0.140)	30	13	19	25	31	38	—	—	—	—	—	—
	50	21	31	42	52	63	—	—	—	—	—	—
	75	31	47	63	79	94	—	—	—	—	—	—
	100	42	63	84	105	125	—	—	—	—	—	—
	125	52	78	105	130	155	—	—	—	—	—	—
	150	63	94	125	155	190	—	—	—	—	—	—
18 (0.180)	30	16	24	32	40	48	56	64	—	—	—	—
	50	27	40	53	67	80	94	105	—	—	—	—
	75	40	60	80	100	120	140	160	—	—	—	—
	100	53	80	110	135	160	190	215	—	—	—	—
	125	67	100	135	170	200	235	270	—	—	—	—
	150	80	120	160	200	240	280	320	—	—	—	—
20 (0.225)	30	20	30	40	50	60	70	80	—	—	—	—
	50	33	50	67	83	100	115	135	—	—	—	—
	75	50	75	100	125	150	175	200	—	—	—	—
	100	67	100	135	165	200	235	265	—	—	—	—
	125	83	125	165	210	250	290	335	—	—	—	—
	150	100	150	200	250	300	350	400	—	—	—	—
24 (0.330)	30	29	44	59	73	88	105	120	130	145	—	—
	50	49	73	98	120	145	170	195	220	245	—	—
	75	73	110	145	185	220	255	295	330	365	—	—
	100	98	145	195	245	295	345	390	440	490	—	—
	125	120	185	245	310	370	430	490	550	610	—	—
	150	145	220	295	365	440	515	590	660	735	—	—
30 (0.530)	30	47	71	95	120	140	165	190	215	235	—	—
	50	79	120	160	195	235	275	315	355	395	—	—
	75	120	175	235	295	355	415	470	530	590	—	—
	100	160	235	315	395	470	550	630	710	790	—	—
	125	195	295	395	490	590	690	790	890	980	—	—
	150	235	355	470	590	710	825	945	1065	1180	—	—

Belt Width, In. (Cross-sect. of Load, Sq. Ft.)	Weight per Cu. Ft. of Mat.	Capacity, Tons Per Hr.—Belt Speed—Fpm. 100	150	200	250	300	350	400	450	500	550	600
36 (0.780)	30	70	105	140	175	210	245	280	315	350	385	420
	50	115	175	235	290	350	410	465	525	585	640	700
	75	175	260	350	435	525	610	700	790	875	960	1050
	100	235	350	465	585	700	815	935	1050	1160	1280	1400
	125	290	435	585	730	870	1020	1170	1310	1460	1600	1750
	150	350	525	700	875	1050	1225	1400	1570	1750	1920	2100
42 (1.085)	30	98	145	195	245	295	345	390	440	490	540	584
	50	165	245	325	410	490	570	650	735	815	900	980
	75	245	365	490	610	735	855	980	1100	1220	1350	1470
	100	325	490	650	815	980	1140	1310	1470	1630	1790	1960
	125	410	610	815	1020	1220	1430	1630	1840	2040	2240	2450
	150	490	735	980	1220	1470	1710	1960	2200	2450	2690	2940
48 (1.460)	30	130	195	265	330	395	460	525	590	655	720	790
	50	220	330	440	545	655	765	875	985	1090	1200	1310
	75	330	490	655	820	985	1150	1310	1480	1640	1810	1970
	100	440	655	875	1095	1310	1530	1750	1970	2190	2410	2630
	125	550	820	1090	1370	1640	1920	2190	2460	2740	3010	3280
	150	655	985	1310	1640	1970	2300	2630	2950	3280	—	—
54 (1.900)	30	170	255	340	425	510	595	680	770	855	940	1020
	50	285	425	570	710	855	995	1140	1280	1420	1560	1710
	75	425	640	850	1070	1280	1490	1710	1920	2130	2350	2560
	100	570	855	1140	1420	1710	1990	2270	2560	2840	3130	3410
	125	710	1070	1420	1780	2130	2490	2840	3200	—	—	—
	150	855	1280	1710	2130	2560	3000	3410	—	—	—	—
60 (2.400)	30	215	325	430	540	650	755	865	970	1080	1190	1300
	50	360	540	720	900	1080	1260	1440	1620	1800	1980	2160
	75	540	810	1080	1350	1620	1890	2160	2430	2700	2970	3240
	100	720	1080	1440	1800	2160	2520	2880	3240	—	—	—
	125	900	1350	1800	2250	2700	3150	—	—	—	—	—
	150	1080	1620	2160	2700	3240	—	—	—	—	—	—

Capacities given are for horisontal conveyors having a uniform feed and load. Inclined conveyors, as a rule, will not handle as many tons per hr. and this should be taken into consideration. If there are peak loads, belts of sufficient capacity to handle material at maximum rate should be used. Where tripper is to be used belt speed generally should not be less than 300 fpm.

Table III—Maximum Lump Size and Idler Spacing for Belt Conveyors

Belt Width, In.	Uniform Size, In.	Mixed with Fines, In.	Idler Spacing 30 lb. Mat.	50 lb. Mat.	75 lb. Mat.	100 lb. Mat.	125 lb. Mat.	150 lb. Mat.	Return Idlers
14	2	3	5′6″	5′0″	5′0″	5′0″	4′6″	4′6″	10′–0″
16	2½	4	5′6″	5′0″	5′0″	5′0″	4′6″	4′6″	10′–0″
18	3	5	5′6″	5′0″	5′0″	5′0″	4′6″	4′6″	10′–0″
20	3½	6	5′6″	5′0″	5′0″	5′0″	4′6″	4′6″	10′–0″
24	4½	8	5′6″	5′0″	4′6″	4′6″	4′0″	4′0″	10′–0″
30	6	12	5′0″	4′6″	4′0″	4′0″	3′6″	3′6″	10′–0″
36	8	15	5′0″	4′6″	4′0″	4′0″	3′6″	3′6″	10′–0″
42	10	18	4′6″	4′6″	4′0″	4′0″	3′6″	3′6″	9′–0″
48	12	22	4′6″	4′0″	4′0″	4′0″	3′6″	3′6″	9′–0″
54	13	25	4′0″	4′0″	4′0″	4′0″	3′6″	3′6″	9′–0″
60	15	28	4′0″	4′0″	4′0″	4′0″	3′6″	3′6″	9′–0″

Additional idlers at approx. 2′0″ centers are recommended at loading points.

Table IV—Recommended Normal and Maximum Belt Speeds, Fpm.

Belt Width	Normal Operating Speed	Maximum Speeds: Light Free Flowing Materials Such as Grains	Moderately Free Flowing Materials Such as Sand, Gravel, Fine Stone and Coal	Lump or Moderately Abrasive Materials Such as R. of M. Soft Coal, Coarse Stone, Crushed Ore	Heavy-Sharp or Very Abrasive Materials as R. of M. Hard Coal, Hard Ore and Coke
14	200	400	250	...	...
16	200	500	300	250	...
18	250	500	300	250	...
20	250	600	400	350	250
24	300	600	400	350	250
30	350	750	500	400	300
36	400	750	500	400	300
42	400	850	550	450	350
48	400	850	550	450	350
54	450	850	550	450	350
60	450	850	550	450	350

The above speeds can be increased slightly under ideal conditions. Recommended belt speeds for special conditions: 300 fpm. minimum for handling wet material. 300 fpm. for conveyors with trippers. 50 to 150 fpm. for picking tables. 150 to 250 fpm. for conveyors with plows 75 to 125 fpm. for package conveyors.

Table V—Critical Factors for Materials to be Handled by Troughing Belt Conveyors

Material	Wt., Lb. Per Cu. Ft.	Angle of Repose	Max. Operating Angle, Deg.
Alumina, sized or briquette	65	22	10
Aluminum hydrate, ground	13½	34	24
Aluminum sulfate, granular	54	32	15
Ash, black, ground	105	27	15
Ash, fly, powdered	45	42	30
Ashes, wet	47	50	38
Ashes, dry	38	40	27
Bauxite, ground dried	68	35	23
Bauxite, mine run	85	31	17
Beans, soy-cake	45	32	18
Beans, soy-meal	40	27	14
Beans, soy-crushed	34	35	22
Beans, soy-whole	47	22	7
Beans, soy-split	44	25	10
Buckwheat	34½	25	13
Barley	39	48	35
Carbon, coke, crushed sized	30	28	13
Cement, clinker	88	33	20
Cement, Portland	95	39	28
Charcoal, wood, pulp granular	26½	35	25
Chips, wood	22	36	25
Cinders (coal, ashes & clinkers)	42	35	23
Cinders, blast furnace	57	35	23
Clay, dry in lump loose		35	21
Clay, blended for tile 11% moist	45	45	31
Clay, ground		35	22
Clay, gray, granular		35	20
Coal, anthracite, broken, loose	54	22	8
Coal, anthracite, chestnut	46	22	8
Coal, bituminus, minus ¼", dry	42	29	15
Coal, bituminus, minus ¼", wet	50	40	25
Coal, bituminus, minus ¼", very wet	55	33	20
Coal, bituminus sized, wet or dry	45	27	14
Copra, medium size pieces	33	20	9
Copra, meal, ground	40	39	25
Copra, expeller cake ground	32	30	16
Copra, expeller cake chopped	29	20	8
Copper sulphate, ground	75	31	17
Clover seed (60 lb. per bu.)	48	28	15
Cocoanut shredded	25	27	15
Coffee beans, green	42	25	10
Coffee, steel cut	28	23	10
Corn shelled (56 lb. per bu.)	45	21	7
Cornmeal (50 lb. per bu.)	40	35	22
Cotton seed	25	29	19
Cotton seed meal	33	35	22
Earth, fullers, raw	42	35	21
Earth, common loam dry loose	76	35	20
Feldspar, crushed	100	32	17
Flax seed (56 lb. per bu.)	45	21	8
Glue (pellet)	45	25	11
Gravel, sharp		40	27
Gravel, round		30	15
Green stone, trap, loose piles	107	35	21
Gypsum	142	45	33
Gypsum in regular lumps	82	30	15
Gypsum ground	56	40	27
Iron oxide pigment	25	40	27
Iron ore—Limonite	237	40	28
Iron ore soft		35	21
Kaolin, green crushed	64	35	19
Kaolin, pulverized	22	45	32
Lead, #70 red	230	40	31
Lead, silicate granulated	230	30	15
Lead sulfate, basic pulverized	184	45	32
Lime, briquette	60	26	15
Lime, burned pebble (sized)	53	30	17
Lime, burned pulverized	27	43	29
Lime, fine (spent dry carbide)	45	40	26
Lime, mason	17	40	27
Lime, hydrated		42	30
Limestone, pulverized	85	47	34
Limestone, mixed sized	105	35	21
Limestone, coarse, sized	98	25	12
Linseed meal	27	34	20
Linseed, rolled	25	34	20
Mica, ground	13½	36	23
Molybdenumite ore, powdered	107	40	25
Manganese	460	39	24
Nitrate of soda	68	24	10
Oats, (32 lb. per bu.)	26	21	8
Phosphate, Dicalcium, granular	60	30	17
Phosphate, Super, ground	51	45	30
Phosphate, Tri-Sodium granular	60	26	13
Phosphate, Tri-Sodium pulverized	50	40	29
Phosphate, Florida	93	27	14
Phthalic anhydride, flaky	42	24	10
Pitch, flake	42	27	13
Rice	50	20	8
Rock, Phosphate, pulverized	60	40	28
Rubber, scrap (ground)	23	35	22
Rye (56 lb. per bu.)	45	32	18
Salt, cake	76	36	21
Salt, granulated	81	31	16
Salt rock, crushed	75	25	11
Sand, mine run	95	35	21
Sand, coarse sized	95	30	16
Sand, very fine	95	32	18
Sand, core	65	39	27
Sand, voids full of water		45	33
Slag, furnace granulated	122	25	13
Slag, Birmingham	82	25	13
Slate, fine ground	82	35	22
Slate, granules flaky	87	28	15
Soap chips	10	30	18
Soda ash light	30	37	25
Soda ash dense	66	32	19
Soda ash briquette	50	22	10
Soda, bicarbonate	43	42	27
Sodium nitrate, granular	68	24	11
Sodium sulfate, (fine and lumps)	88	31	18
Sulfa, pulverized	50	45	30
Sulfa, coarse	76	32	20
Sawdust, drip	20	36	22
Sawdust, ground	20	45	31
Shale	85	39	26
Wheat (60 lb. per bu.)	48	23	10
Zinc ore roasted granular	110	38	27

tripper which can be made to discharge on both sides or on either side.

Impact idlers are designed with rubber rolls which serve to relieve the belt from shock due to loading heavy lumps.

Disk return idlers are used on belts handling sticky materials which adhere to the belt and which tend to build up on the return idlers coming in contact with it.

Belt conveyors are easy to maintain once they are installed properly and the cost of handling materials is low. Horsepower requirements are relatively small with the use of anti-friction bearings which also reduce the necessity of frequent lubrication.

Screw Conveyors

The screw conveyor is among the simplest and most versatile types of material handling equipment. It can:

1. Convey horizontally, on an incline or vertically.
2. Accommodate multiple inlet and discharge openings, the latter fitted with control gates.
3. Provide troughs designed for dust tight conditions.
4. Provide for a variety of flight and trough thicknesses.
5. Provide flights made ½, ¼, full and double pitch depending upon the problem encountered. It can be used as a feeder, either as an independent unit or as a part of a conveyor.
6. Convey both ways in one unit by means of right and left hand flights.

Screw conveyors consist of metal flights formed as a helix and mounted on a pipe.

The helicoid type is made by cold rolling a continuous strip to form a helix of desired diameter, pitch and thickness to fit a given size pipe or shaft. The flighting is secured to the pipe by end lugs welded to the back face of the flights and by intermediate space welds. The flighting is tapered in cross-section, having about twice the thickness at the pipe as at the outer edge.

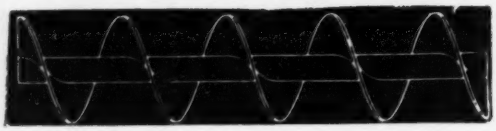
In the sectional flight type, the flights are made in sections equal to one pitch of the helix and are secured to each other by lapping and riveting as indicated, or by butt welding. Pitch of the screw is usually made equal to its diameter, thus a 9 in. diameter screw is made 9 in. pitch.

For special problems involving corrosion, temperature, etc. flights and pipe can be made of Monel, stainless steel, aluminum, brass or special alloy steels. They can also be cast either in sections or continuously. For resisting abrasion, steel flights may be tipped with Stellite or similar materials. Rubber has also been used to cover the flights to resist chemical action or wear.

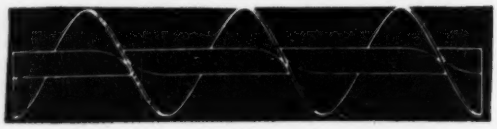
The helicoid conveyor has the advantage over the

Helicoid Conveyor Variations

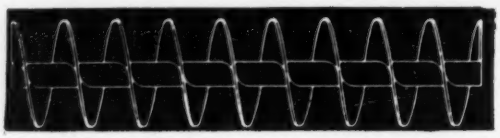
Single Flights



STANDARD PITCH—For inclines up to 20 deg.

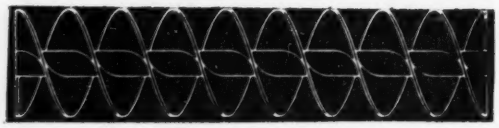


LONG PITCH—For hi-capacity, free-flowing material.

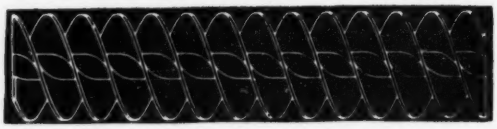


SHORT PITCH—For feeders or for slow conveying.

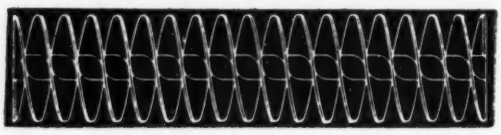
Multiple Flights



DOUBLE—For higher capacity, even-flow feeders.

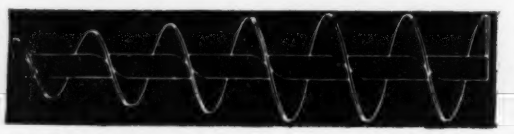


TRIPLE—For feeders handling free-flowing material.

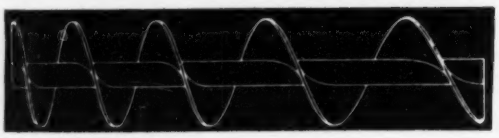


DOUBLE, SHORT PITCH—For smooth flow, slow material.

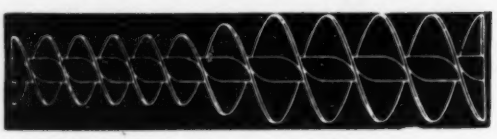
Special Flights



TAPERED—For special feeders.

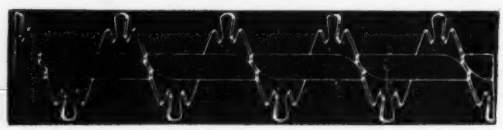


VARIABLE PITCH—For special feeders.

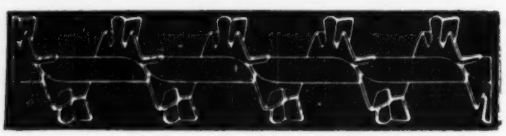


TAPERED DOUBLE—For special feeders.

Cut Flights



CUT—For mixing and retarding material.



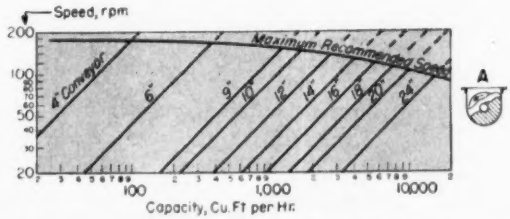
CUT AND FOLDED—For mixing and retarding material.

CUT WITH PADDLES—For mixing and retarding.

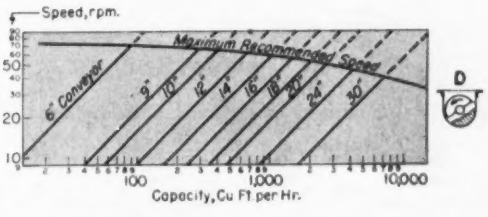
sectional flight type in that the continuous flights add strength, and there are no crevices or voids where materials might lodge. The helicoid is applied more to non-abrasive materials, grains, etc.

The sectional flight conveyor has the advantage where special features are required such as odd diameters or pitches, large diameters or extra thickness of flights, and hardened-flights or flights of special materials. Worn or damaged flights are more easily replaced. While Table VI shows sizes up to 16-in. diameter inclusively, sizes 18, 20, 22 and 24-in. are readily obtainable in the sectional-flight type.

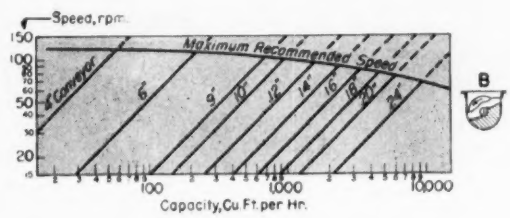
Capacity Charts for Standard Screw Conveyors



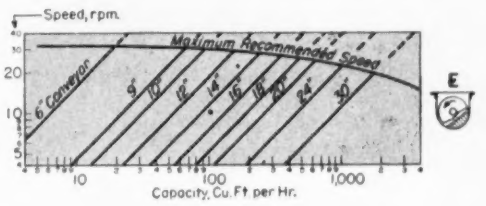
CAPACITY CHART A—Light, fine, non-abrasive and free flowing materials, weighing up to 30 or 40 lb. per cu. ft., such as pulverized coal, air separated hydrated lime and flour. Average percent of cross-section in material—45%.



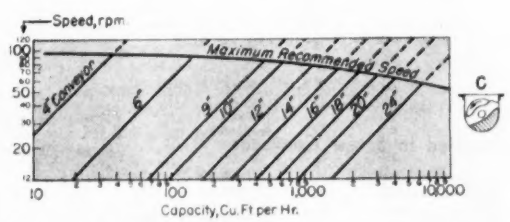
CAPACITY CHART D—Semi-abrasive or abrasive materials, consisting of fines, granular or small lumps mixed with fines and weighing from 50 to 100 lb. per cu. ft., as cement, shale, gypsum, ground or pebble lime, etc. Average percent of cross-section in material—25%.



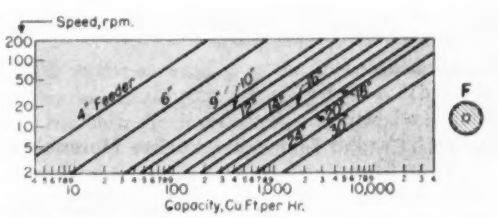
CAPACITY CHART B—Medium weight, non-abrasive, granular or small lump materials mixed with fines and weighing up to 40 or 50 lb. per cu. ft., such as cereals, light soda ash, sawdust and cottonseed, reasonably clean and of average moisture. Average percent of cross-section in material—38%.



CAPACITY CHART E—Highly abrasive, lumpy or stringy materials, which must be carried at a low level in the trough to avoid contact with the hanger bearings or interference with the hanger frames, as ashes, coke, flue dust, etc. Average percent of cross-section of material—12½%.



CAPACITY CHART C—Non-abrasive or semi-abrasive granular or small lump materials mixed with fines and weighing from 40 to 70 lb. per cu. ft., such as bituminous coal or screenings, refined sugar, coarse salt and dense soda ash. Avg. percent of cross-section in material—31%.



CAPACITY CHART F—Applies for conveyor almost fully loaded as in the case of feeders, and in a general way may be used for all the types of material in Table VIII, with due allowance for lumps. Average percent of cross-section in material—90%.

*Shaded portion of trough outline shows average level of material in trough. Upper line shows approximate maximum height under reasonable loading. Some material must be kept low in trough and away from hangers to prevent degradation through working in and out of bearings. This has been taken into consideration in these charts. Short pitch screws naturally reduce the rate of travel of the material which is somewhat offset by the higher level in the trough due to the closer pitch. Multiple flight standard pitch conveyors have higher capacities than those shown for corresponding standard conveyors as shown in charts.

Standard spacings of conveyor supporting hangers are 8 ft.-0 in. for 4-in. conveyors, 10 ft.-0 in. for 9-in. and 10-in. conveyors and 12 ft.-0 in. for all others. Standard conveyor sections are made to suit this spacing although special lengths can be furnished if desired.

Ribbon conveyors are a modification of the helicoid and are used on sticky materials where the solid flights will not clear themselves. Fig. 17 shows other modifications.

Frequently short feeder sections are made part of a screw conveyor line where material is to be fed from bins and conveyed some distance. Feeder sections should be made no longer than a standard length section to avoid the use of hangars. A close clearance between flights and trough must be maintained throughout the length and the cross-section is completely filled with material being handled. Fine-mesh materials which hang up in bins and suddenly let go tend to flush past standard-pitch screws so on such installations short pitch flights are recommended.

For the most part the steel troughs are made "U" shaped in cross-section and in 10 ft. long sections. They can be furnished in various gages of thickness depending upon the service requirements. Most troughs are covered

and where extreme dust conditions are encountered special attention should be given to the details of the cover and to the end bearings. The outside bearing has found favor on an increasing number of installations where dusty, abrasive conditions are met. .

Selection of a screw conveyor can become rather complicated at times and usually it is best to call in a specialist for recommendations. However, as a guide, Table VII together with charts (page 205) will serve to clarify the application of screw conveyors to a particular problem.

Table VI—Comparison of Helicoid and Sectional Flight Screw Conveyors, Range of Flighting Available

Helicoid			Sectional Flight				
	Thickness of Flight, In			Thickness of Flight, Ga., In.			
Size* Diam., In.	Inner Diam.	Outer Diam.	Size Diam., In.	Intermediate Flights	End Flight	Nominal Inside Diam. Of Pipe, In.	Diam. Of Coupling, In.
4 Std.	1/8	1/16				1 1/4	1
4 X	3/16	3/32				1 1/4	1
6 Std.	1/8	1/16	6	16	10	2	1 1/2
6 X	1/4	1/8	6	10	10	2	1 1/2
6 XX	3/8	3/16	6	3/16	3/16	2	1 1/2
			6	1/4	1/4	2	1 1/2
			9	14	10	2	1 1/2
9 Std.	3/16	3/32	9	10	10	2	1 1/2
9 X	3/8	3/16	9	3/16	3/16	2	1 1/2
9 Special	3/16	3/32	9	14	10	2 1/2	2
9 XX	3/8	3/16	9	10	10	2 1/2	2
9 XXX	1/2	1/4	9	3/16	3/16	2 1/2	2
			9	1/4	1/4	2 1/2	2
			9	3/8	3/8	2 1/2	2
			10	14	10	2	1 1/2
10 Std.	3/16	3/32	10	10	10	2	1 1/2
10 XX	3/8	3/16	10	14	10	2 1/2	2
			10	3/16	3/16	2 1/2	2
			10	1/4	1/4	2 1/2	2
			12	12	3/16	2 1/2	2
12 Std.	1/4	1/8	12	3/16	3/16	2 1/2	2
12 X	3/8	3/16	12	1/4	1/4	2 1/2	2
12 XX	3/8	3/16	12	12	3/16	3	2 7/16
			12	3/16	3/16	3	2 7/16
12 XXX	1/2	1/4	12	3/16	3/16	3 1/2	3
			12	1/4	1/4	3 1/2	3
			12	3/8	3/8	3 1/2	3
			14	12	3/16	3	2 7/16
14 Std.	1/4	1/8	14	3/16	3/16	3	2 7/16
14 XX	7/16	7/32	14	3/16	3/16	3 1/2	3
			14	1/4	1/4	3 1/2	3
			14	3/8	3/8	3 1/2	3
			16	10	3/16	3 1/2	3
			16	3/16	3/16	3 1/2	3
			16	1/4	1/4	3 1/2	3
16 Std.	5/16	5/32	16	3/8	3/8	3 1/2	3
16 XXX	1/2	1/4				4	3

* Standard designations

Table VII—Critical Factors for Various Materials to Be Handled in Screw Conveyors

Material	Wt. per Cu. Ft., Lb.[1]	Capacity Classification See P. 205	Recommended Hanger Brgs. & Cplings[2]	Horsepower Factor, F[3]
Alum, lumpy	50-60	C	Ba(a)	1.4
Alum, pulverized	45-50	B	Ba(a)	0.6
Asbestos, shred	20-25	C	Ba	1.0
Ashes, dry	35-40	E	WI	4.0
Ashes, wet	45-50	E	WI	5.0
Bakelite and similar plastics	30-40	D	Wd	1.4
Bauxite, crushed, dry	75-85	D	WI	1.8
Beans, castor	36	D	Ba	0.5
Beans, soy	45-50	B	Ba	0.5
Bone black	20-25	D	WI	1.7
Borax	50-55	C	Ba	0.7
Calcine flour	75-85	D	Ba	0.7
Carbon black, granular	25	C	LB	0.4
Carbon black, powdered	4-6	C	LB	0.4
Cement, portland	75-85	D	WI	1.4
Chalk, crushed	85-90	D	WI	1.9
Chalk, pulverized	70-75	D	WI	1.4
Charcoal	18-28(g)	C	Ba	1.4
Clay, brick or tile, dry, ground	100-120	D	WI	2.0
Coal, fines or slack	40-45	B	Ba	0.9
Coal, pulverized	32-35	A	Ba	0.6
Coal, sized	45-50	C	Ba	1.0
Coal, lignite	45-55	C	Ba	1.0
Cork, ground	12	C	Ba	0.5
Corn, shelled	45	B	Ba	0.4
Corn grits	42-43	B	Ba	0.5
Cottonseed, dry	25	C(b)	Ba	0.9
Cottonseed cake, cracked	40-45	C	Ba	1.0
Cottonseed hulls	12	B	Ba	0.9
Cottonseed meal	35-40	A	Ba	0.4
Cottonseed meats, dry	45-50	B	Ba	0.6
Dolomite	75-90	D	WI	2.0
Feldspar, ground	65-70	D	WI	2.0
Flue dust, blast furnace	110-125	E	WI	3.5
Fluorspar	110	D	WI	2.0
Fly-ash, boiler house	30-45(g)	E	WI	3.5
Foundry sand	90-100	D	WI	2.0
Fullers earth, raw	35-40	D	WI	2.0
Fullers earth, spent, 35% oil	60-65	D	WI	2.0
Gelatin, granulated	32	B(h)	Wd(e)	0.8
Graphite, flake	40	B(h)	Ba	0.4
Graphite, flour	28	B	Ba	0.4
Gypsum, calcined	55-60	C	WI	1.2
Gypsum, crushed	90-100	D	WI	1.6
Hominy	37	A	Ba	0.4
Ice, crushed	35-45	B(d)	Ba	0.4
Lard	59	C	Wd	0.4
Lead oxides	30-150(g)	D	WI	1.0
Lime, ground (unslaked)	60	C	Ba(e)	0.6
Lime, hydrated	35-45	B	Ba(e)	0.8
Lime, hydrated, pulverized and air separated	32-40	A	Ba(e)	0.6
Lime, pebble	56	D	Ba(e)	1.3
Limestone dust	75-85	D	WI	1.6
Limestone screenings	85-90	D	WI	2.0
Linseed cake, pea size	48-50	B	Ba	0.6
Linseed meal	44	A	Ba	0.4
Lithopone	45-50	D	Wd	1.0
Malt, dry, crushed	20-22	A	Ba	0.4
Malt, dry, whole	27-30	A	Ba	0.4
Malt, wet or green	60-65	C	Ba	0.4
Malt, meal	36-40	A	Ba	0.4
Mica, flake	17-22	C	WI	1.4
Milk, dried, flake	36	C	Wd	1.0
Milk, malted	27	C	Wd	0.9
Oats	26	A	Ba	0.4
Oleomargarine	59	C	Wd	0.4
Ore, zinc, flotation	65-80(g)	D	WI	1.7
Paper pulp stock, 4% or less	62	C	Wd(f)	0.9
Paper pulp stock, 6% to 15%	60-62	D	Wd	1.2
Paraffin cake, broken	45	D	Ba	0.6
Peanuts, shelled	20-25	D	Ba	0.5
Peanuts, unshelled	15-20	D	Ba	0.7
Phosphate, acid, pulverized, 6% to 8% moisture	60	D	WI	1.4
Phosphate, granular	90	D	WI	1.6
Pumice, ground	42-45	D	WI	1.6
Quartz, pulverized or granular	110	E	WI	2.5
Rice, clean	45-48	A	Ba	0.4
Rice grits	42-45	A	Ba	0.4
Rye	44	A	Ba	0.4
Salt, coarse	45-51	C	Ba(e)	1.2
Salt, dry fines	70-80	C	Ba(e)	1.0
Sand, dry	90-110	D	WI	2.0
Sand, silica, dry	90-100	E	WI	2.0
Sawdust	13	C	Ba	0.7
Shale, crushed	85-90	D	WI	2.0
Shavings, wood	15	C	Ba	1.0
Slate, crushed	80-90	D	WI	2.0
Soap, powdered	20-25	C	Ba	0.9

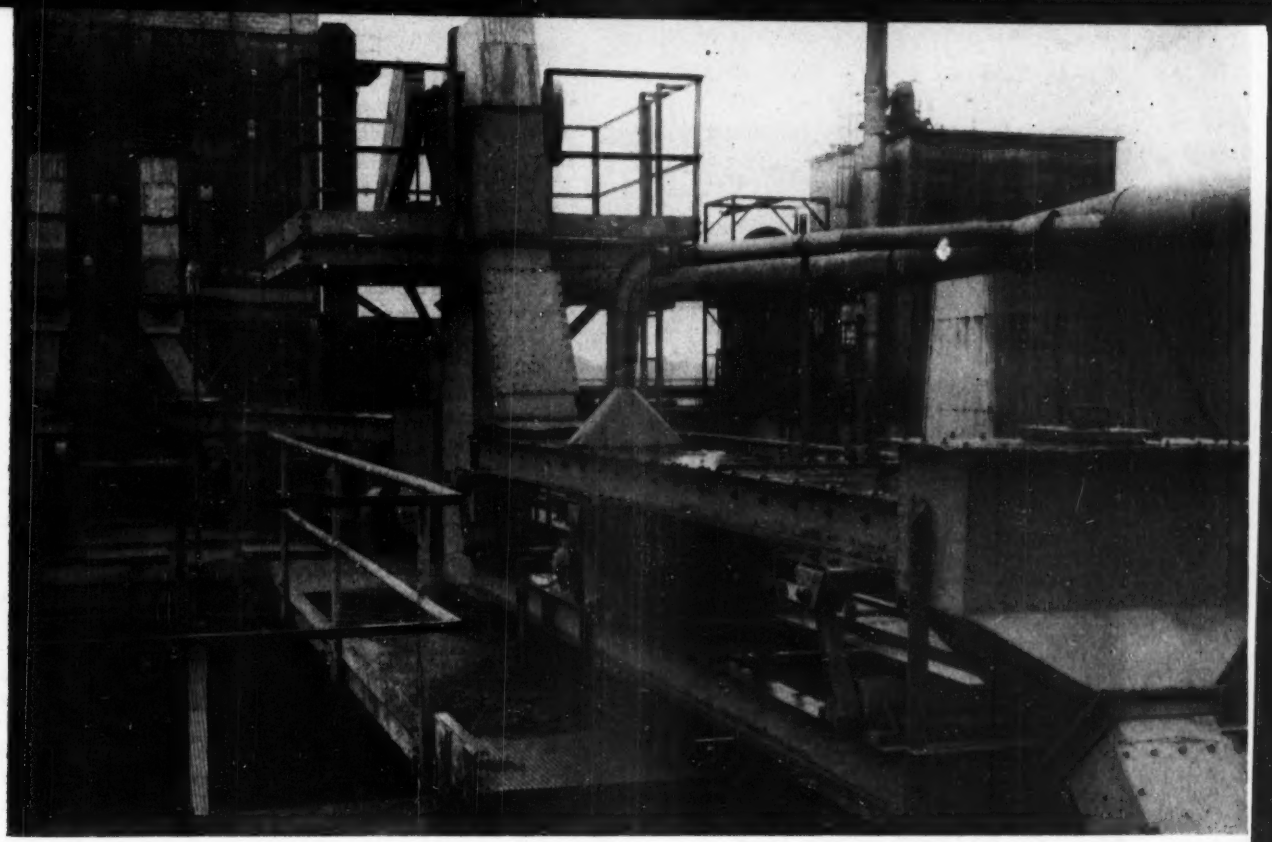


Fig. 19—Vibrating conveyor. This type was developed to handle materials not successfully handled by other types of conveyors.

Table VII, cont.

Soda, ash, dense	55–65	C	WI	0.7
Soda ash, light	20–35(g)	C	WI	0.7
Starch	45	C	Ba	1.0
Sugar, raw	55–65	D	Ba	1.0
Sugar, refined	50–55	C	Wd	0.7
Sugar beet pulp, dry	12–15	C	Ba	0.9
Sugar beet pulp, wet	25–45(g)	C	Ba	0.9
Sulfur, lumpy	80–85	D	Ba	0.8
Sulfur, powdered	50–60	D	Ba	0.7
Talc	50–60	C	Ba	0.6
Tankage	60–62	C	Ba	0.6
White lead	35–55(g)	D	WI	1.0
Zinc oxide	10–35(g)	D	Wd	1.0

(a) Where contamination must be avoided, use Wd. (b) Conveyors handling cottonseed may be operated at speeds 60% to 75% in excess of the maximum recommended by the curve on chart C, p. 205. (c) For food products, Wd may be preferable. (d) Lump size may necessitate selection of larger conveyor than indicated for the volume only, on chart "B," p. 205. (e) Some operators prefer WI. (f) Open side hangers are recommended. If other hangers are used, it may be necessary to step down to class D or E. (g) The wide variations in weight are due to grade or conditions of material as produced for specific commercial purposes, or to moisture content. (h) To reduce degradation by keeping material low in trough, it is sometimes advisable to use charts D or E, p. 205.

[1] Weights apply for material when slightly agitated or fluffed, as when handled by screw conveyors. In this condition the weight is generally less than when the materials are settled or packed in bins or containers.

[2] Symbols for hanger bearings and couplings: Ba—Babitted bearings, grease lubricated, and cold rolled steel couplings. Bronze bearings, grease lubricated, may also be used. LB—Self-lubricating bronze bearings and cold rolled steel couplings. Wd—Hard maple or lignum vitae bearings, oil or paraffin impregnated (self-lubricating). Cold rolled steel couplings. WI—White iron bearings (usually non-lubricated) with hardened steel couplings. Stellite bushings, or hardened steel bearings may also be used. Manganese steel couplings sometimes employed.

[3] H. P. = 1 + [DLN + CWLF]/1,000,000. D = Conveyor factor*, L = length, ft., N = rpm., C = cu. ft. per hr., W = lb. per cu. ft., F = factor in Table VII.

* Conveyor factors, D, for various types of hanger bearings

Diameter of Conveyor, In.	Lignum Vitae, Babbitt or Bronze	Self-Lubricating Bronze	White Iron or Stellite
3	15	24	36
4	21	33	51
6	33	54	78
9	54	96	132
10	66	114	162
12	96	171	246
14	135	255	345
16	186	336	480
18	240	414	585
20	285	510	705
24	390	690	945
30	549	975	1,320

Mechanical and Electrical Vibrating Conveyors

More recent acquisition to the field of conveying materials are the vibrating conveyors (Fig. 19). This type conveyor has been developed to fill the need for a horizontal conveyor to handle materials of a difficult nature which cannot be successfully handled by other types.

In fact they are in some cases replacing other such units because of their simplicity of construction and freedom from maintenance.

As will be noted from Figs. 20-22, the conveying medium is a metal pan or tube without obstructions to hinder the easy flow of material. Supporting members are set on an angle of about 30 deg. from the vertical which produces an upward as well as a forward tossing action. This saves wear on the trough and speeds the travel of the material.

Difficult materials (such as those of a stringy, elongated nature; granular, hot, abrasive materials either fine or coarse) are easily conveyed without trouble. Since the troughs can be made of corrosion resisting materials and can be enclosed, such materials as foodstuffs and chemicals may be carried without fear of contamination and dust escape. The trough or tube is completely self-cleaning, thus avoiding chances of mixing the various materials.

Because of its simple construction the vibrating conveyor is readily adapted to drying or cooling materials enroute without danger of leakage or degradation of the materials conveyed.

The power unit for electrical vibrating conveyors having short strokes and high frequencies operates at such

Fig. 20—Mechanical vibrating conveyor.

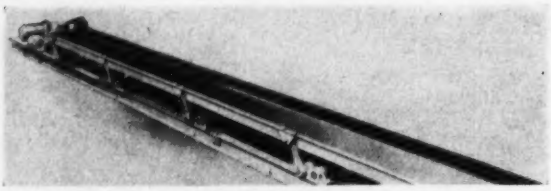


Fig. 21—Mechanical vibrating conveyor.

Fig. 22—Electrical vibrating conveyor.

frequencies as 60, 50, 30 or 25 cycles in combination with special vibrator bars attached to this type of equipment.

The power unit for the mechanical vibrating conveyor is usually an eccentric driven by a standard electric motor. It is attached to the trough by some form of connecting rod.

Depending upon the design, the length of stroke can be anywhere between ¼ and 1½-in. and the corresponding speeds between about 1,000 and 400 rpm. Supporting members may be cantilever springs (Fig. 20) or made rigid to co-operate with springs provided to supply the needed restoring forces (Fig. 21). The drive is usually arranged for a speed close to the natural frequency of the moving system to reduce the power required to maintain operation. Where vibration to the supporting structure is a factor, special methods are provided to reduce it to a safe figure.

Capacities of mechanical and electrical vibrating conveyors vary with the speeds and strokes. They depend upon the resulting travel speed of the material and its depth of bed in the trough. A conservative travel speed for mechanical vibrators is about 30 fpm. Electrical vibrators can be varied over a considerable range by means of their rheostat control.

Although both of these types may be operated up-hill a limited amount, capacities are reduced an appreciable amount. The manufacturer should be consulted for such problems.

Selection Depends on Ten Factors

There are a number of factors which govern the choice of equipment for handling material in bulk:

1. Location of receiving and discharge points.*
2. Space available for the installation.
3. Whether material to be elevated, conveyed or both.
4. Weight per cubic foot of the material.
5. Capacity in tons or cubic feet per hour.
6. Nature of the feed, whether uniform or in surges.
7. Character of service, continuous or intermittent.
8. Power required to operate.
9. Characteristics of the material to be handled.
10. Relative cost.

Usually items 1, 2, 4, 5 and 7 are not too difficult to determine in the field, while item 3 is generally found by some sort of layout. Method of bringing material to an elevating or conveying unit (item 6) is an important factor in keeping them trouble free. If flooding occurs because of the lack of a proper feeding device the cost of maintenance rises rapidly and the installation loses its benefits. There are places, however, where the feed can be regulated with a gate or by the even discharge coming from another elevating or conveying unit in the system.

Since it takes considerably more power to drag material than to carry it, choice of unit will sometimes be governed by making comparisons of this factor, others being equal.

The factor most affecting the selection comes from a study of the material characteristics (item 9) of the material to be handled. Table VIII shows a comprehensive list of material characteristics against which have been charted the various types of bulk material handling equipment being considered in this report. Since several types may fulfill the requirements of a given problem, the selection may not always be exact and the final choice will depend upon one or more of the other nine factors.

Wherever there is doubt about an elevating or conveying unit successfully handling material of known characteristics, the space in Table VIII opposite the particular characteristic is marked by an "x." If a bucket elevator is indicated for a proposed application, there are certain characteristics such as extreme abrasiveness, degradation, etc. which will preclude the choice of the centrifugal-discharge type in favor of the continuous-type. Where the characteristics are such that the chart shows there is no choice, the relative cost must be considered. Since the centrifugal type is cheaper in first cost it may be favored. It is well to point out here however that the first cost is not always the cheapest in the long run especially where the service is continuous. The centrifugal-type operates at about three times the speed of the continuous and maintenance becomes a factor.

Table IX contains many materials not identified with the chemical industry but will be helpful in comparing them with a chemical not listed and being considered in a material handling problem.

*It is sometimes quite important that loading and discharge points should be located to permit the use of equipment particularly adapted to handle material of certain characteristics. Too many times the design of building and location of processing equipment ignores the requirements of good material handling equipment so the final selection can only be a compromise.

Table VIII—Guide for Conveyor and Elevator Selection

Material Characteristics (See also Key, Table X)	Elevators									Conveyors							Elevator-Conveyor				
	Centrifugal Discharge Chain and Bucket	Centrifugal Discharge Belt and Bucket	Continuous Bucket Chain and Bucket	Continuous Bucket Belt and Bucket	Positive Discharge	Gravity Discharge	Pivoted Bucket	En Masse	Screw	Belt	Screw	Apron	Scraper	Vibrating	En Masse	Chain Drag	En Masse	Gravity Discharge	Pivoted Bucket	Tubular Scraper	Zipper
Size																					
Very fine (−100 mesh)	1	1	O	O	O	X	X	X	X	O	O	X	X	X	O	X	X	X	X	O	O
Fine (100–1/8")	O	O	O	O	O	X	O	O	O	O	O	O	X	O	O	O	O	X	O	O	O
Granular (1/8"–1/2")	O	O	O	O	O	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Lumpy (+1/2")	2	2	O	O	2	O	O	3	X	O	6	O	O	O	3	O	3	O	O	4	5
Irregular (fibrous, etc.)	X	X	X	X	X	X	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Flowability (Repose Angle)																					
Very free flowing (<30°)	O	O	O	O	7	O	O	O	X	O	O	X	O	O	O	O	O	O	O	O	O
Free flowing (30°–45°)	O	O	O	O	7	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Sluggish (>45°)	X	X	X	X	O	X	X	X	X	O	8	X	X	X	X	X	X	X	X	X	X
Abrasiveness																					
Non-abrasive	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Mildly abrasive	O	O	O	O	O	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Very abrasive	X	O	O	O	X	X	O	X	X	O	9	10	X	O	X	O	X	X	O	X	O
Special Characteristics																					
Contaminable	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X	X	X	X	X	O
Hygroscopic	X	X	X	X	O	X	O	X	X	O	8	X	X	X	X	X	X	X	O	X	O
Highly corrosive	X	O	X	O	X	X	O	14	14	O	14	X	X	O	14	X	14	X	O	X	O
Mildly corrosive	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Harmful fumes and dust	O	O	O	O	O	X	X	O	O	11	O	11	11	O	O	11	O	X	X	O	O
Explosive dust	12	12	12	12	12	X	X	12	X	12	12	X	X	O	12	X	12	X	X	O	O
Degradable	X	X	O	O	X	X	O	13	X	X	X	X	X	O	13	X	13	X	O	13	O
Very light and fluffy	X	X	O	O	O	X	O	O	O	O	O	X	O	O	O	X	O	X	O	O	O
Interlocks or mats	X	X	O	O	X	X	O	X	X	O	X	X	X	O	X	X	X	X	O	X	X
Aerates and becomes fluid	X	X	O	O	O	X	X	O	O	X	O	X	X	X	X	X	O	X	X	O	O
Packs under pressure	X	X	O	O	X	X	O	X	X	O	X	X	X	O	X	X	X	X	O	X	X
High temperature (over 200° F.)	O	X	O	X	O	X	O	X	O	X	O	O	O	O	X	O	X	X	O	X	X

O = OK to use. X = doubtful.

1. Very fine free flowng materials heavier than about 50 lb. per cu. ft. will handle satisfactorily.
2. Maximum lump size which may be safely handled depends upon the size of the elevator buckets and the percentage of lumps in the aggregate. For instance a 6" x 4" bucket will handle ½" maximum lump size where the percentage of lumps is 100% and 2½" where the percentage is 10%. With a 16" x 8" bucket these sizes become 1½" and 4½".
3. Maximum lump size of material containing not more than 15% lumps is ¾" for smallest size 3" x 5", and 2½" for largest size 9" x 13".
4. Maximum lump size 1½".
5. See manufacturer for maximum lump size.
6. Maximum lump size for 6" screw is ¾" where there are 25% lumps, and ½" where there are 100%. On 20" screw the corresponding lump sizes are 3½" and 2".
7. On free flowing materials the positive discharge elevator is higher in cost and has no advantage over the centrifugal or continuous types.
8. Sluggish materials can be frequently handled by the ribbon type screw conveyor. See manufacturer for recommendations.
9. Very abrasive materials can be handled successfully in screw conveyors by using oversize units and selecting the proper flight, trough and hanger materials.
10. The "No-Leak" type can be adapted to handle highly abrasive materials.
11. Must be completely housed.
12. Must be fully housed and provided with explosion doors.
13. Within certain limitations of lump size, flowability, path of travel, etc., these conveyors will handle certain materials without undue degradation.
14. For materials of corrosive nature the use of special alloy metals make these units applicable.

Table IX—Characteristics of Bulk Materials, for Use in Conjunction with Table VIII

Key to Table:

	Material Characteristics	Class
Size	Very fine—minus 100 mesh	A
	Fine—100 mesh to ⅛ in.	B
	Granular—⅛ to ½ in.	C
	Lumpy—containing lumps ½ in. and over	D
	Irregular—being fibrous, stringy, or the like	H
Flowability	Very free flowing—angle of repose up to 30°	1
	Free flowing—angle of repose 30° to 45°	2
	Sluggish—angle of repose 45° and up	3
Abrasiveness	Non-abrasive	6
	Mildly abrasive	7
	Very abrasive	8

	Material Characteristics	Class
Special Characteristics	Contaminable, affecting use or saleability	K
	Hygroscopic	L
	Highly corrosive	N
	Mildly corrosive	P
	Gives off dust or fumes harmful to life	R
	Contains explosive dust	S
	Degradable, affecting use or saleability	T
	Very light and fluffy	W
	Interlocks or mats to resist digging	X
	Aerates and becomes fluid	Y
	Packs under pressure	Z

Example: A material which is granular, very free flowing, mildly abrasive and mildly corrosive would fall in classes C, 1, 7, and P. Classification C17P.

Material	Class	Avg. Wt. Per Cu. Ft., Lbs.*
Alfalfa meal	B36W	17
Alum, lumpy	D26	50–60
Alum, pulverized	B26	45–50
Alumina	B28	60
Aluminate jell	B27	45
Aluminum hydrate	C26	18
Aluminum chips	C36X	15
Aluminum ore	D28	75–85
Aluminum oxide	A27	120
Aluminum silicate	B26	49
Ammonium chloride, crystalline	B26	52
Antimony powder	B27	
Asbestos shred	H37WZ	20–25
Ashes, coal, dry, minus ½ in.	C27	35–40
Ashes, coal, wet, minus ½ in.	C37PZ	45–50
Ashes, coal, dry, minus 3 in.	D27	35–40
Ashes, coal, wet, minus 3 in.	D37PZ	45–50
Asphalt, crushed, minus ½ in.	C26	45
Bagasse	H36X	7–8
Bakelite, powdered	A36	30–40
Barite or baryte	D28	180
Bark, wood, refuse	H37X	10–20
Barley	B16S	38
Bauxite, crushed, minus 3 in.	D28	75–85
Beans, castor	C16	36
Beans, castor, meal	B26	
Bentonite, minus 100 mesh	A26Y	51
Bicarbonate of soda	A26	41
Blood, dried	D37	
Bones, crushed, minus ½ in.	C27	35–40

Table IX—Characteristics of Bulk Materials, *cont.* . . .

Material	Class	Avg. Wt. Per Cu. Ft., Lbs.*
Bones, granulated or ground, minus ¼ in.	B27	50
Boneblack, minus 100 mesh	B27	20–25
Bonechar, minus ½ in.	B27	40
Bonemeal	B27	55–60
Borate of lime	A26	
Borax, powdered	B26	53
Boric acid, powdered	B26	
Brewer's grain, spent, dry	C36	25–30
Brewer's grain, spent, wet	C36P	55–60
Brick, ground, minus ½ in.	B28	
Calcium carbide	D27	
Carborundum, minus 3 in.	D28	100
Casein	B27	36
Cast iron borings	C37	130–200
Cement, portland	A27Y	75–85
Cement clinker	D28	75–80
Chalk, crushed	D37Z	85–90
Chalk, pulverized, minus 100 mesh	A37YZ	70–75
Charcoal	D37T	18–25
Cinders, blast furnace	D38	57
Cinders, coal	D28	40
Coal, anthracite, 50 mesh to ½ in.	B28P	60
Coal, anthracite, river or culm, minus ½ in.	B38P	60
Coal, anthracite, sized, ½ to 6 in.	D26T	
Coal, bituminous, mined, fines, minus 50 mesh	B36P	50
Coal, bituminous, mined, slack, minus ½ in.	D26P	50
Coal, bituminous, mined, sized	D26PT	50
Coal, bituminous, mined, run of mine	D26PT	50
Coal, bituminous, stripping, not cleaned	D37PZ	50
Coffee, chaff	B26WY	
Coffee, green bean	C26T	32
Coffee, ground	B26	25
Coffee, roasted bean	C16	22–26
Coke, loose	D28TX	23–32
Coke, petroleum	D27X	25–42
Coke breeze, minus ½ in.	C28	25–34
Copper ore	D28	120–150
Copper sulphate (bluestone)	D26	
Copperas	B27	50
Copra meal	B26	40–45
Coral	D28	
Cork, fine ground	B36WY	12–15
Cork, granulated, minus ½ in.	C26	12–15
Corn, cracked	C16	45–50
Corn, seed	C16S	45
Corn, shelled	C16S	45
Corn germs	B26	21
Corn grits	B26	42–43
Corn sugar	B26	31
Cornmeal	B26	38–40
Cottonseed, dry, de-linted	C26	25
Cottonseed, dry, un-delinted	C36	18–25
Cottonseed cake, cracked	D26	40–45
Cottonseed hulls	B26W	12
Cottonseed meal	B26	35–40
Cottonseed meats	B26	40
Cracklings, crushed, minus 3 in.	D36	
Cryolite	D27	
Cullet	D28	80–120
Dicalcium phosphate	A36	
Dolomite, crushed	D27	90–100
Ebonite, crushed, minus ½ in.	C26	
Epsom salts	B26	
Feldspar, ground, minus ½ in.	B27	65–70
Feldspar, powdered, minus 100 mesh	A27	75
Ferrous sulfate	C26	
Flue dust, boiler house, dry	A17Y	110–125
Fluorspar	C27	82
Fly ash, dry	A14Y	35–40
Fuller's earth, burnt, oil refinery	B28	40
Fuller's earth, raw, oil refinery	B27	35–40
Gelatin, granulated	C26T	32
Glass batch	D28	90–100
Glue, ground, minus ½ in.	B27	40
Glue, pearl	C16	40
Gluten meal	B26	40
Grains, distillery, spent, dry	H26W	30
Graphite, flake	D26	40
Graphite, flour	A16Y	28
Graphite ore	D27	
Gypsum, calcined	C27	55–60
Gypsum, crushed, under 1 in.	D27	90–100
Gypsum, powdered	B37	60–80
Ice, crushed	D16	35–45
Ilmenite ore	B28	140
Iron oxide, mill scale	B27	
Iron sulfate	C26	
Kaolin clay, minus 3 in.	D27	163
Kaolin talc, minus 100 mesh	A36	
Lead arsenate	B26R	72
Lignite, air dried	D26	45–55
Lime, ground, minus ½ in.	B26Z	60
Lime, hydrated	B26YZ	40
Lime, pebble	D26	56
Lime, over ½ in.	D26	53
Limestone, agricultural, minus ¼ in.	B27	68
Limestone, crushed	D27	85–90
Linseed (see flaxseed) Lithopone	A26Y	45–50
Magnesium chloride	C36	33
Maize	B16S	
Malt, dry ground, minus ½ in.	B26W	22
Malt, dry, whole	C26S	27–30
Malt, wet or green	C36	60–65
Malt meal	B26	36–40
Manganese ore	D28	
Manganese sulfate	C28	70
Marble, crushed, over ½ in.	D28	90–95
Marl	D27	80
Mica, ground	B26	41
Mica, pulverized	A26Y	
Mica flakes	B16WY	17–22
Milk, dried flake	B26K	36
Milk, malted	A36K	27
Muriate of potash	B28	77
Mustard seed	B16S	45
Oats	C16S	26
Oats, rolled	C26SW	19
Orange peel, dry	H36	15
Oxalic acid crystals	B36L	60
Oyster shells, whole	D27X	
Oyster shells, ground, minus ½ in.	C27	
Peanuts, shelled	C26	20–25
Peanuts, in shells	D26T	15–20
Peas, dried	C16ST	45–50
Phosphate rock	D27	75–85
Plaster of Paris	A26Z	50
Pumice, ground, minus ½ in.	B38	42–45
Rice, hulled or polished	B16	45–48
Rice, rough	B26S	36
Rice bran	B26SW	20
Rice grits	B26	42–45
Rubber, ground	C26	23
Rye	B16S	44
Salt, dry fine	B26PL	70–80
Salt, dry coarse	C26PL	45–40
Salt cake, dry coarse	D26	85
Salt cake, dry pulverized	D26	65–85
Saltpeter	B26S	80
Sand, damp bank	B38	110–130
Sand, dry bank	B28	90–110
Sand, dry silica	B18	90–100
Sand, foundry, prepared	B38	90
Sand, foundry, shakeout	D28	90
Shale, crushed	C27	85–90
Shellac, powdered or granulated	B26	
Silica gel	B28	45
Slag, furnace	D38X	160–180
Slag, furnace, granulated	C28	60–65
Soap beads or granules	B26T	
Soap chips	C26T	5–15
Soap flakes	B26T	
Soap powder	B26	20–25
Soapstone talc	A27	165–170
Soda ash, light	A27W	20–38
Soda ash, heavy	C27	55–65
Sodium phosphate	A26	
Sodium sulfate	B26	45
Soybeans, cracked	B26S	32–36
Soybeans, whole	B17S	45–50
Soybean cake, over ½ in.	D26	40–43
Soybean flakes, raw or spent	C26W	18–26
Soybean meal, cold	B26	40
Soybean meal, hot	B26P	40
Steel chips, crushed	D38	25–85
Stone, crushed	D28X	85–90
Stone, screenings	C28	85–90
Stone, dust	B28Y	75–85
Sugar cane, knifed	H36X	15–18
Sugar, granulated	B26KT	50–55
Sugar, raw	B37Z	55–65
Sulfur, crushed, minus ½ in.	C26S	50–60
Sulfur, lumpy, minus 3 in.	D26S	80–85
Sulfur, powdered	B26SY	50–60
Talcum powder	A27Y	50–60
Timothy seed	B26SW	36
Tobacco leaves dry	H36TX	12–14
Tobacco scraps	D36W	15–25
Tobacco, snuff	B36TY	30
Tobacco, stems	H36X	15
Traprock, crushed	D28X	105–110
Trisodium phosphate	B27	60
Tung nut meats, crushed	D26	25
Vermiculite, expanded	C36W	16
Vermiculite ore	D26	80
White lead	C26	74
Wood shavings	H36WX	15
Zinc oxide, light	A36WZ	10–15
Zinc oxide, heavy	A36Z	30–35

*Weight of material loose or slightly agitated. This weight is generally less than that of settled or packed material, as in bins or containers.

Credits: Chain Belt, Figs. 9-11; Continental Gin, Figs. 15, 17, 18, Tables II-V, VII; Hapman Conveyors, Fig. 6; Jeffrey Mfg., Figs. 13, 16, 22; Link-Belt, Pix p. 195, Figs. 1-5, 12, 14, 19-21, Table IX; Stephens-Adamson, Figs. 7, 8.

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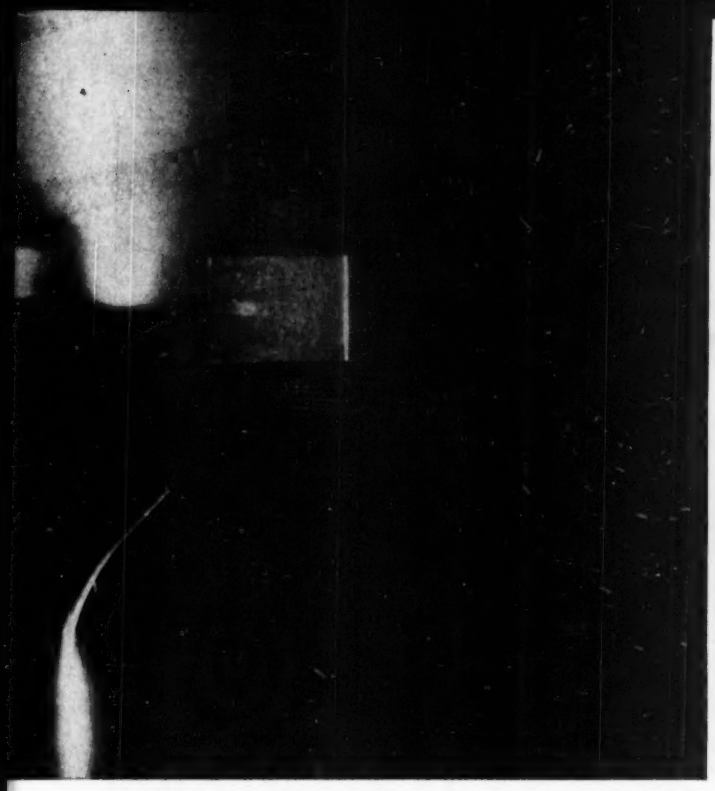

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Chemical Engineering Fundamentals

Chemical Equilibrium—II

THOMAS E. CORRIGAN, Research Engineer, Mathieson Chemical Corp., Niagara Falls, N. Y.

In our first installment on chemical equilibrium (*Chem. Eng.*, p. 222, Mar. 1954), we were interested in the energy effect we get when a reaction takes place. Now our attention turns to the method for finding out how far a reaction will go. The meaning of the equilibrium constant and how to calculate it will be considered.

We will discuss the meaning of standard state and its importance, not only in determining the equilibrium constant, but also in using the constant. This second installment will be devoted to the significance of the equilibrium constant and the mathematical relationships between enthalpy, entropy and equilibrium composition.

Free Energy As an Equilibrium Criterion

As we have seen (*Chem. Eng.*, p. 239, Oct. 1953), the decrease in free energy of a system during the isothermal process is a measure of the net reversible work that the system can do upon its surroundings: $-\Delta G = w_f$.

In most chemical reactions (except those which take place in an electrical cell) there is no opportunity for the system to do any work other than that of expansion. In other words, the system is not subjected to any external force other than pressure.

Equilibrium conditions are those in which, for any conceivable change, the forces resisting the change are just balanced by those tending to cause it. Therefore, any small change that would take place would have to be a reversible one.

Since a reversible process is one which takes place always at equilibrium conditions, the criteria of reversibility must also be the criteria for equilibrium conditions. (We are neglecting the differential driving force needed for a reversible process to proceed at all.)

Since for a reversible process — $dG = dw_f$, and since $w_f = 0$, then if a process is at equilibrium for a differential change that it might undergo $dG = 0$. The free energy is useful in calculating the composition of the equilibrium mixture because most chemical reactions of industrial importance are restricted to constant pressure.

For a pure substance the relation between free energy, temperature and pressure is:

$$dG = -SdT + Vdp$$

When a process is restricted to constant pressure, $dG = Vdp$ since $-S\,dT = 0$, and

$$\Delta G = \int_{p_1}^{p_2} V\,dp$$

If the substance is an ideal gas, $V = RT/p$ and

$$\Delta G = \int_{p_1}^{p_2} RT\frac{dp}{p} = RT \ln (p_2/p_1) \qquad (1)$$

This same expression could conceivably be applied to a single component of a mixture of ideal gases:

$$G_A = RT \ln (p_{A2}/p_{A1})$$

In the equation above G_A is that part of the free energy of the mixture that is attributable to component A, and p_A is the partial pressure of A. This expression is valid for an isothermal change involving a change in the partial pressure of component A even though the total pressure on the system remains constant.

Equilbrium Constant for Ideal Gases

Eq. (1) serves as the basis for chemical equilibrium calculations. When a chemical reaction takes place at constant temperature and pressure, the free energy of the system continues to decrease as long as the reaction proceeds spontaneously.

When the free energy has reached the lowest value possible for the system at that temperature and pressure, the reaction will cease. Any furtherance of the reaction in the same direction would have to be accompanied by an increase in free energy. Therefore, it could not occur unless some extra force (for instance, electromotive) were applied to the system.

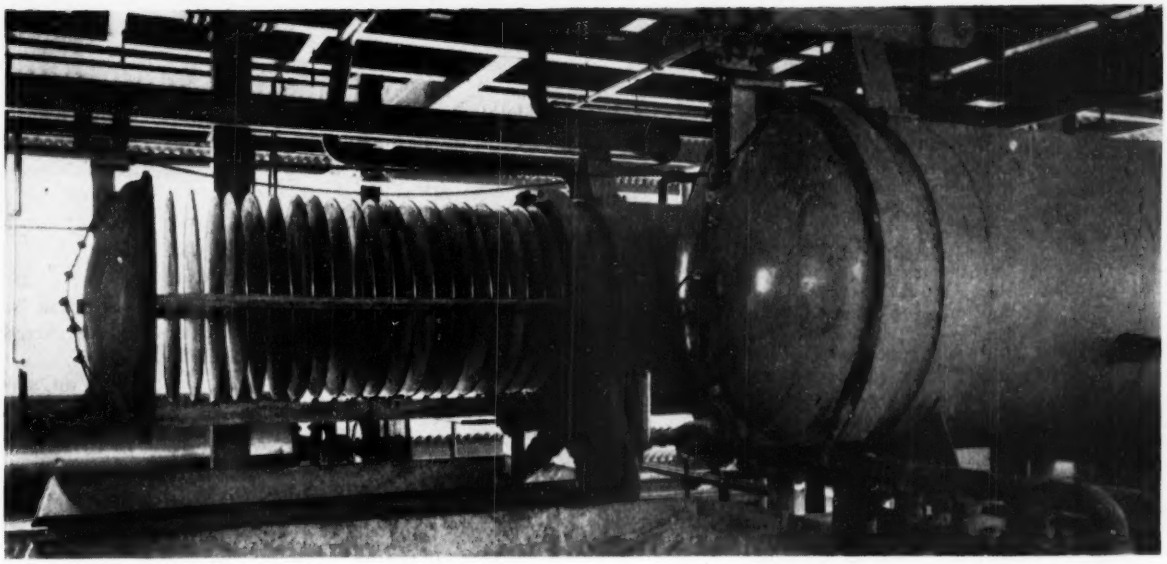
In most reactions there is no extra force applied and the reaction stops at the point where the free energy reaches the minimum value. The composition of the mixture of reactants and products is the equilibrium composition. It is this composition that chemical engineers are interested in calculating for the purpose of estimating the maximum possible yield of a process.

The actual value of the free energy at this point has little practical significance. However, we shall see that through the use of the free energy relationships we can calculate the equilibrium composition.

Let's consider the application of these principles to a specific chemical reaction. The water gas shift reaction,

$$CO + H_2O \rightleftarrows CO_2 + H_2$$

is one of universal interest to engineers. We can



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Nomenclature (Consistent units)

a, b, c, d	Reacting moles of A, B, C, D, etc.
A, B, C, D	Components in a mixture
C_p	Heat capacity at constant pressure
C_{pm}	Mean heat capacity at constant pressure
d	Differential operator
f	Fugacity
f°	Fugacity in some specified state
G	Free energy
g	Partial molal free energy
G°	Free energy in some specified state
H	Enthalpy
H°	Enthalpy in some specified state
ΔH_T°	Heat of reaction, specified state, temperature T
ΔH_S	Heat of reaction at standard temperature T_S
K	Equilibrium constant
p, p_c, p_r	Pressure, critical pressure, reduced pressure
p°	Partial pressure in some specified state
p^*	Partial pressure in an equilibrium mixture
R	Universal gas constant
S	Entropy
s	Partial molal entropy
S°	Entropy in some specified state
S_S°	Entropy, specified state, standard temperature
T	Absolute temperature, °K. or °R.
T_S	A standard temperature
V	Volume
v	Partial molal volume
z	Compressibility factor
Δ	Finite change in a property
λ	Latent heat of vaporization
ν	Fugacity coefficient
Σ	Summation of

Additional subscripts

A, B, C, D	Of component A, B, C, D, etc.
P	Of the products
R	Of the reactants

---

abbreviate this reaction as follows:

$$A + B \rightleftarrows C + D$$

We will consider the free energy changes of the system involved in the following hypothetical steps:

1. One mole of A and one mole of B originally pure, at 1 atm. pressure, and at the temperature of the system are put into a large amount of mixture of A, B, C and D which is already at the equilibrium composition.

2. The mole of A and B react in this equilibrium mixture to form C and D. This step must be reversible since the mixture is already at equilibrium.

3. The newly formed C and D are removed from the mixture and are restored to the pure state.

The free energy of Step 2 will be zero (since this step is at equilibrium at all times), but that of Steps 1 and 3 will be finite. The free energy change of the whole process, that of converting one mole of pure A and one of pure B to one each of pure C and pure D, is referred to as the standard free energy change. This is the sum of the free energy changes in Steps 1, 2 and 3.

In Step 1 the free energy change would be the free energy of one mole of A in the mixture minus the free energy of one mole of pure A plus the same quantity for B. Thus,

$$\Delta G_1 = (g_A - G_A^\circ) + (g_B - G_B^\circ)$$

where g_A refers to that part of the free energy of the mixture that is attributable to A and is called the partial molal free energy of A. Similarly for Step 3:

$$\Delta G_3 = (G_C^\circ - g_C) + (G_D^\circ - g_D)$$

The terms are reversed because we are removing C and D from the mixture. The total or standard free energy is the sum:

$$\Delta G^\circ = \Delta G_1 + \Delta G_2 + \Delta G_3$$

or,

$$\Delta G^\circ = (g_A - G_A^\circ) + (g_B - G_B^\circ) + 0 + (G_C^\circ - G_C) + (G_D^\circ - g_D) \quad (2)$$

Eq. (2) is not very useful in this form, but it can be made so by using the relationship between free energy and partial pressure.

The free energy relationship, $dG = -SdT + Vdp$, may be applied to a single component in the gaseous mixture, thus:

$$dg_A = -S_A\,dT + V_A\,dp$$

At constant temperature $dT = 0$ and

$$dg_A = V_A\,dp \quad (3)$$

where g_A is the partial molal free energy and p is the pressure of component A. The change in free energy of A accompanying a change in pressure can be obtained by integrating Eq. (3) between the proper limits. In Step 1, A goes from the pure state and 1 atm. pressure to its partial pressure in the equilibrium mixture. Therefore,

$$\int_{G_A^\circ}^{g_A} dg_A = \int_{p_A^\circ}^{p_A^*} V\,dp$$

For the simple case of ideal gases, $V = RT/p_A$ and

$$\int_{G_A^\circ}^{g_A} dg_A = RT \int_{p_A^\circ}^{p_A^*} \frac{dp_A}{p_A}$$

or,

$$g_A - G_A^\circ = RT \ln p_A^*/p_A^\circ$$

where the asterisk refers to the partial pressure of A in the mixture when the mixture is at equilibrium.

By a similar method we can obtain the following expressions:

$$g_B - G_B^\circ = RT \ln p_B^*/p_B^\circ$$
$$G_C^\circ - g_C = RT \ln p_C^\circ/p_C^*$$
$$G_D^\circ - g_C = RT \ln p_D^\circ/p_D^*$$

Therefore the standard free energy change equation,

$$\Delta G^\circ = (g_A - G_A^\circ) + (g_B - G_B^\circ) + 0 + (G_C^\circ - g_C) + (G_D^\circ - g_D)$$

becomes

$$\Delta G^\circ = RT \ln p_A^*/p_A^\circ + RT \ln p_B^*/p_B^\circ + RT \ln p_C^\circ/p_C^* + RT \ln p_D^\circ/p_D^*$$

Combining the p* and p° terms separately we may write:

$$\Delta G^\circ = RT \ln \frac{p_A^* p_B^*}{p_C^* p_D^*} + RT \ln \frac{p_A^\circ p_B^\circ}{p_C^\circ p_D^\circ} \quad (4)$$

Since the terms p_A°, p_B°, p_C°, and p_D° refer to the pure gas at 1 atm. pressure, they are each equal to 1.0 and the last term of Eq. (4) becomes zero. Eq. (4) is usually written with the partial pressure ratios inverted and a negative standard free energy change,

$$-\Delta G^\circ = RT \ln \frac{p_C^* p_D^*}{p_A^* p_B^*} \quad (5)$$

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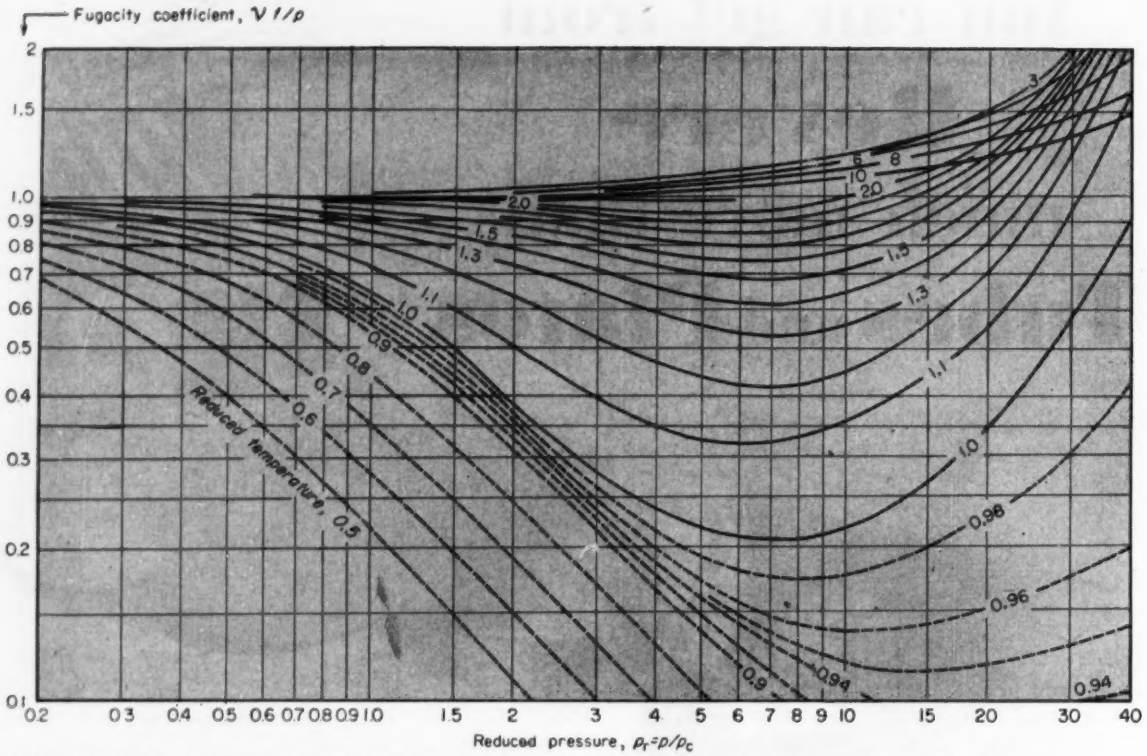

GENERALIZED FUGACITY COEFFICIENT chart plots the coefficient vs. reduced pressure (from Ref. 1).

The ratio of partial pressures in the right-hand term of Eq. (5) is always equal to a constant value for any given temperature, regardless of the values of the individual terms such as p_A*. This constant varies only with the temperature since $\Delta G°$ is a function of the temperature only. It is called the equilibrium constant, K. Therefore,

$$-\Delta G° = RT \ln K$$

and

$$K = (p_C p_D)/(p_A p_B)$$

We will drop the asterisks from this point on and p_A will be understood to mean the equilibrium partial pressure of A.

For the general equation for any reaction involving ideal gases,

$$aA + bB + \cdots = cC + dD + \cdots$$

Similar logic could be applied to show that for ideal gases,

$$K = (p_C{}^c p_D{}^d)/(p_A{}^a p_B{}^b)$$

Equilibrium Composition of Non-Ideal Gases

The equations which we developed above are limited to ideal gases only. In order to provide similar equations but which would be useful for all substances, G. N. Lewis[2] has developed the new term fugacity.

This is an arbitrarily defined term. When it is substituted for pressure in the equations above it will make them applicable for all substances. The mathematical definition of fugacity is

$$dG = RT\, d(\ln f)$$

where f is the fugacity. Using fugacities instead of partial pressures the equilibrium equation for the above reaction would be:

$$-\Delta G° = RT \ln \frac{f_C f_D}{f_A f_B} + RT \ln \frac{f_C{}° f_D{}°}{f_A{}° f_B{}°} \qquad (6)$$

where f terms refer to fugacities of the components in the equilibrium mixture and the $f°$ terms refer to the fugacities of the same components in some specified state.

Since the numerical value of the fugacity of a substance is often difficult to calculate, the ratio of the fugacity at one state to that at some arbitrarily defined state is often used. We call this second state the standard state and the ratio is known as the activity. Activity is defined as:

$$a = f/f°$$

where $f°$ refers to the fugacity of the substance in question at the standard state. Although any arbitrary standard state may be chosen, custom has limited this choice.

In the study of chemical equilibria involving gas reactions, the standard state is chosen as that in which the fugacity of the pure gas is equal to unity. This, for most gases, means the pure gas at 1 atm. pressure. The standard state temperature must be the same as that of the system for which we are calculating the equilibrium composition.

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JET HELPS ACID TANKS "BREATHE"

From **CHEMICAL AND ENGINEERING NEWS**
American Chemical Society
Vol. 29, Page 410, January 29, 1951

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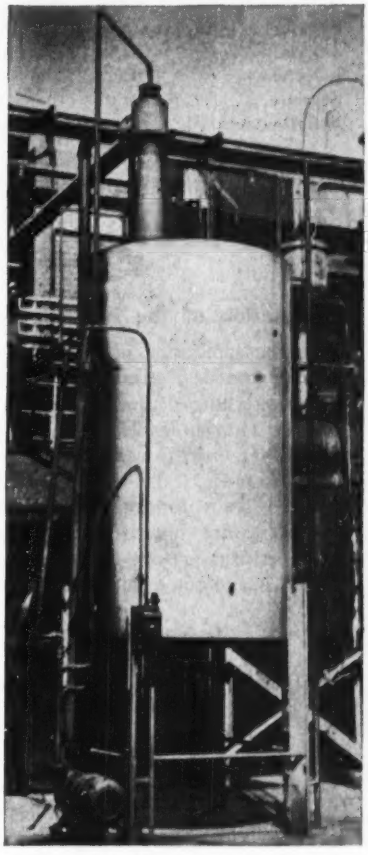
Proper venting of storage tanks containing fuming sulfuric acid, or oleum, can present a serious problem in a chemical plant. The escaping sulfur trioxide tends to clog the vent and build up pressure in the tank. At best, the fumes escaping are a source of atmospheric pollution.

SK Fig. 4010 Fume Scrubber.

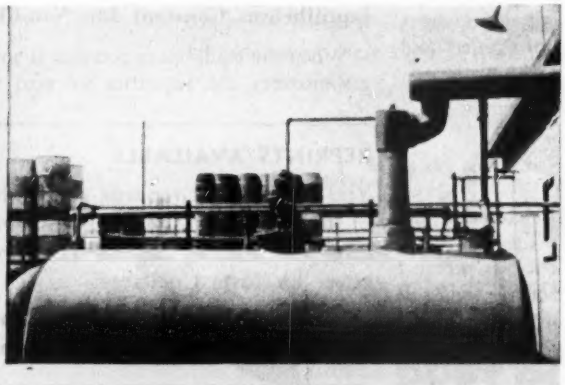
The Hilton-Davis Chemical Co. division of Sterling Drug Co. at Cincinnati, Ohio, found an ingenious solution to this problem. The 12,000-gal. oleum tank was vented through an SK Haveg Fume Scrubber installed on an adjoining tank containing 93% sulfuric acid. A pump supplied the jet with 93% sulfuric acid from the tank. Noxious fumes from the oleum are piped to the Fume Scrubber inlet and the circulating 93% acid effectively absorbs the sulfur trioxide. The system has proved highly successful in keeping the vents clear and eliminating atmospheric pollution.

Similar installations have been used to absorb fumes from such reactions as sulfide reductions, chlorosulfonic or oleum sulfonations.

For complete details on all types of SK Fume Scrubbers and their characteristics, write for Bulletin 4-R.



SK Fume Scrubber mounted on fuel oil tank absorbs sulfide reduction fumes.



Oleum tank in building connected by vent to SK Fume Scrubber mounted on 93% acid tank. Immersed acid pump supplies jet through small lines.

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Standard Molal Entropies of Organic Compounds†

(Ideal gaseous state, 1 atm., unless otherwise noted)

	$S°$		$S°$
Methane	44.46	Nonane (l)	94.0
Acetylene	48.08	Benzene	64.39
Ethylene	52.75	Benzene (l)	41.49
Ethane	54.86	Cyclohexane	71.41
Propylene	65.06	Naphthalene (s)	39.9
Propane	64.69	Anthracene (s)	49.6
Isobutene	71.28	Methanol	57.72
Butene	75.38	Ethanol (l)	38.4
Isobutane	70.51	Isopropanol (l)	43.0
Isobutane (l)	52.09	Formaldehyde	52.42
Toluene	76.44	Acetone	72.7
Toluene (l)	52.40	Acetone (l)	47.9
Octane	110.69	Chloroform	70.82
o-Xylene	84.50	Methyl chloride	55.94
p-Xylene	84.27	Phosgene	67.24
Styrene	82.07	Formic acid	60.0
Ethylbenzene (l)	61.3	Methylamine	57.73

†Selected from Hougen, O. A. and K. M. Watson, "Chemical Process Principles," Table 35, John Wiley & Sons, New York (1947).

Calculation of the Fugacity of Gases

In the application of the chemical equilibrium equation to non-ideal gases it is the fugacities and not the partial pressures that are important. Therefore, we must have a means of relating the fugacity to the partial pressure in order to use the equation.

Fugacity is really another arbitrarily defined term which is really a measure of the deviation of a gas from ideality. Since this is the case, there must be a relationship between fugacity and the compressibility factor, z, which is another measure of this deviation.

$$\ln (f/p) = \int_0^p \left(\frac{z-1}{p}\right) dp \qquad (7)$$

From Eq. (7), charts have been made which permit the calculation of the fugacity of those non-ideal gases that obey the law of corresponding states. Such a chart is shown on the preceding page. The ordinate is the ratio of fugacity to pressure (f/p) and is called the fugacity coefficient. This is plotted against reduced pressure with reduced temperature as a parameter. The fugacity coefficient chart may also be used to calculate the fugacity of individual components of gaseous mixtures and, in addition, to calculate the fugacity of a pure liquid at its vapor pressure.

Fugacity Calculation Problems

Example 1—Calculate the fugacity of ammonia gas at 250 deg. F. and 1,000 psig.

Solution—The procedure will be to determine the fugacity coefficient from the generalized fugacity coefficient chart and then to use the ratio, $f = \nu p$, where f equals fugacity, ν equals fugacity coefficient, and p is the partial pressure of the material in question. In this case p is 1,000 psig. since the gas phase is pure ammonia.

T_c = 132.4° C. and p_c = 111.5 atm.

p = 1,014.7/14.7 = 69 atm.

p_r = 69/111.5 = 0.618

T_c = 132.4° C. = 405.5° K. = 720° R.

T = 250° F. = 710° R.

T_r = 710/720 = 0.986

From the generalized fugacity coefficient chart:

ν = 0.78 (approx.)

$f = \nu p$ = (0.78)(69) = 53.8 atm. = 792 psia.

Example 2—Calculate the fugacity of pure liquid ammonia at 120 deg. F. and 100 psig.

Solution—The fugacity of liquids can also be calculated from the generalized chart. Here we take advantage of the fact that at the vapor pressure the fugacity of the gas and liquid are equal because the liquid and the vapor are in equilibrium. Therefore, the procedure is as follows:

1. At the temperature specified, evaluate T_r ($T_r = T/T_c$).
2. At the temperature specified look up the vapor pressure and use this as the pressure of the gas phase. Evaluate p_r from the vapor pressure (p_r = vapor pressure/p_c).
3. Using these values of p_r and T_r evaluate the fugacity coefficient ν and calculate the fugacity of the gas at the vapor pressure.
4. This is also the fugacity of the liquid at the vapor pressure.
5. Correct the fugacity of the liquid from that at the vapor pressure to that at the specified pressure. For liquids this correction is small and may often be neglected.

T = 120° F. = 580° R.

T_r = 580/720 = 0.805

$p°$ = 286.4 psia. = 19.5 atm.

p_r = 19.5/111.5 = 0.175

ν = 0.875 (estimated)

$f_L = \nu p°$ = (0.875)(19.5) = 17.1

If we assume that the correction of the fugacity of the liquid is small between 19.5 atm. and 100 psig. (7.8 atm.), the fugacity of the liquid can be taken as 17.1 atm. at 120 deg. F. and 100 psig. Liquid ammonia, at these conditions, is in an unstable state and would proceed to evaporate.

Equilibrium Constant for Non-Ideal Gases

When the equilibrium constant is applied to non-ideal gas mixtures, the fugacities are used instead of partial

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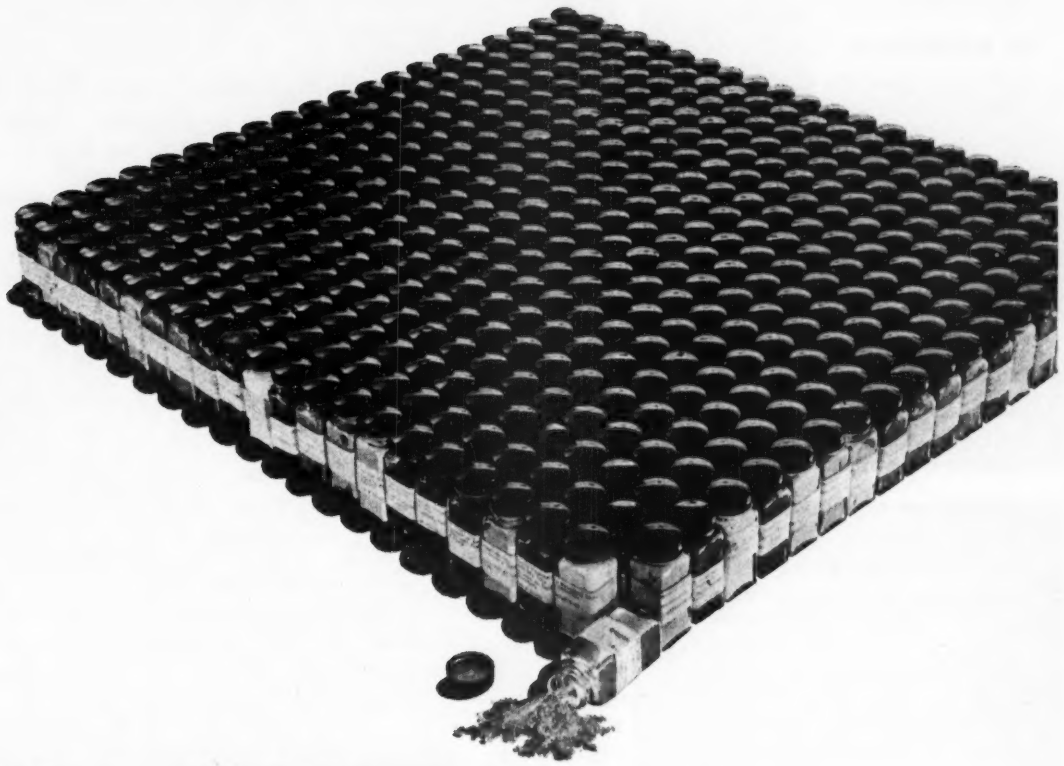

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pressures. Then the equilibrium equation for the reaction,

$$A + B \rightleftarrows C + D$$

becomes

$$K = (f_C f_D)/(f_A f_B)$$

but since $f_A = \nu_A p_A$, this may be written

$$K = (\nu_C p_C \nu_D p_D)/(\nu_A p_A \nu_B p_B)$$

or,

$$K = (\nu_C \nu_D p_C p_D)/(\nu_A \nu_B p_A p_B)$$

$$= K\nu \left(\frac{p_C p_D}{p_A p_B}\right)$$

where $K\nu = (\nu_C \nu_D)/(\nu_A \nu_B)$. Here $K\nu$ is a direct measure of the effect of non-ideality of the gases upon the equilibrium composition.

Calculation of the Equilibrium Constant

The equilibrium constant K for a chemical reaction may be calculated from a knowledge of the heat of the reaction and the entropy change of that reaction. Since $-\Delta G = RT \ln K$, and also since

$$\Delta G^\circ = \Delta H^\circ - T\,\Delta S^\circ$$

for a process taking place at constant temperature it is necessary that ΔH° and ΔS° be calculated at the temperature in question. The calculation of ΔH_T° has been discussed previously. (*Chem. Eng.*, p. 226, Mar. 1954).

$$\Delta H_T = \Delta H_S^\circ + \int_{T_S}^{T} \Delta C_p\, dT$$

or if mean heat capacities are used

$$\Delta H_T = \Delta H_S + \Delta C_{pm}(T - T_S)$$

The entropy change of the reaction at temperature T can be evaluated in a similar manner using the expression

$$\Delta S_T = S_S^\circ + \int_{T_S}^{T} \frac{\Delta C_p}{T}\, dT$$

The standard entropy change of the reaction is the entropy change at some reference temperature such as 60 deg. F. or 25 deg. C. This can not be measured experimentally but may be calculated from the absolute entropies of the substances taking part in the reaction. These standard absolute entropy values are generally tabulated for the more common chemical compounds. We have shown some values in the table above.

The calculation of absolute entropy of many substances is possible because the substances follow the third law of thermodynamics. This states that the absolute entropy of a pure substance in the crystalline state is zero at the temperature of absolute zero. Thus, if the latent heats of all the phase changes are known and if the heat capacity is known, the absolute entropy of the pure substance may be calculated by the following equation:

$$S^\circ = \Sigma\lambda/T + \Sigma \int C_p\, dT/T$$

Entropies calculated in this manner were compared with absolute entropies computed back from measurable equilibrium constants and were found to check quite closely.

If the standard free energy change of the substances involved in a chemical reaction were tabulated the standard free energy change (and thus K) for a given reaction could be calculated directly.

Equilibrium Constant Calculation Problems

Example—Calculate the equilibrium constant for the dissociation of NH_4Cl into NH_3 and HCl (g) at 1,000 deg. K. (1,340 deg. F.).

Solution—This problem will be solved by using the relations $\Delta G^\circ = -RT \ln K$ and $\Delta G = \Delta H - T\Delta S$, where the terms represent the properties of 1 mole of solid NH_4Cl decomposing into 1 mole of NH_3 and 1 mole of HCl (g) at 1,000 deg. K.

$$NH_4Cl\ (s) \rightleftarrows NH_3\ (g) + HCl\ (g)$$

Compound	ΔH_f cal./gm.-mole at 18°C.	S° cal./gm. mole-°K. at 25° C.
NH_4Cl (s)	−74,950	31.8
NH_3 (g)	−11,000	46.03
HCl (g)	−22,060	44.66

	C_p (cal./gm. mole-°K., T in °K.)
NH_4Cl (s)	$9.8 + (3.68)(10^{-2})T$
NH_3 (g)	$6.189 + 7.887(10^{-3})T - 0.728(10^{-6})T^2$
HCl (g)	$6.70 + 0.840(10^{-3})T$

The first step is to calculate the heat of reaction at 1,000 deg. K. We will calculate the standard heat of reaction and then correct this to 1,000 deg. K.

$$\Delta H_{18} = \Sigma(\Delta H_f)_P - \Sigma(\Delta H_f)_R$$
$$= -11{,}000 - 22{,}600 + 74{,}950$$
$$\Delta H_{18} = 40{,}800 \text{ cal./gm.-mole}$$

Next, correct ΔH_{18} for temperature

$$\Delta H_T = \Delta H_{18} + \int_{291}^{1{,}000} \Delta C_p\, dT$$

$$\Delta H_T = \Delta H_{18} + \Delta C_{pm}(1{,}000 - 291)$$

The mean heat capacities work out to be as follows:

NH_4Cl, 33.6; HCl, 7.25; and NH_3, 11.29.

$$\Delta H_T = 40{,}890 - 15.1(1{,}000 - 291)$$
$$\Delta H_T = 30{,}190 \text{ cal./gm.-mole}$$

A similar procedure may be used to calculate ΔS_T°.

$$\Delta S_{25} = \Sigma S^\circ_P - \Sigma S^\circ_R = 58.9$$

Next correct ΔS° for temperature using the expression

$$\Delta S^\circ_T = \Delta S^\circ_{25} + \int \Delta C_p\, dT/T$$
$$\Delta S^\circ_T = \Delta S^\circ_{25} + C_{pm} \ln T/T_S$$

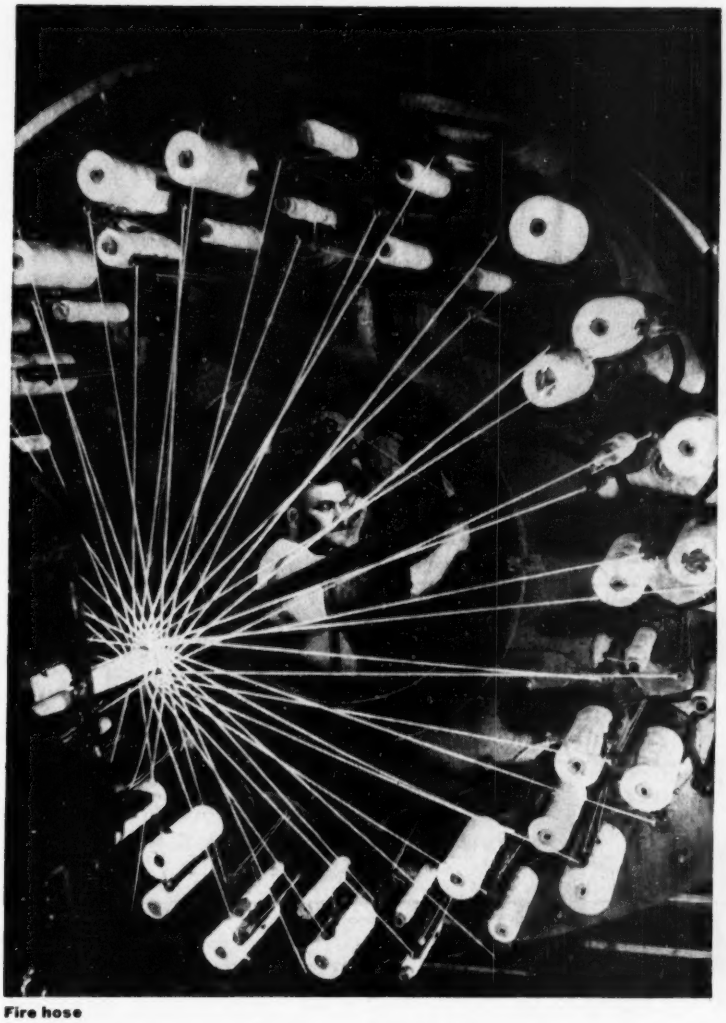
Since 18 deg. C. and 25 deg. C. are so close, we may assume the mean heat capacity between 298 and 1,000 deg. K. to be the same as between 291 and 1,000 deg. K. This gives us ΔS_T° as equal to 40.7. We now have ΔH and ΔS at the reaction temperature. The next step is calculate ΔG. $\Delta G = \Delta H - T\Delta S = -10{,}510$ cal./gm. mole.

The equilibrium constant is calculated from the relation $\Delta G = -RT \ln K$. The equilibrium constant is 200.

REFERENCES

1. Gamson, B. W. and K. M. Watson, *Natl. Petroleum News*, Tech. Sec., 36, p. R623, Sep. 6 (1944).
2. Lewis, G. N. and M. Randall, "Thermodynamics and the Free Energy of Chemical Substances," McGraw-Hill Book Co., Inc., New York (1923).

Next Month—Chemical Equilibrium-III will discuss the calculation of equilibrium conversion for various reactions, the effect of dissociation on the theoretical flame temperature and standard states.



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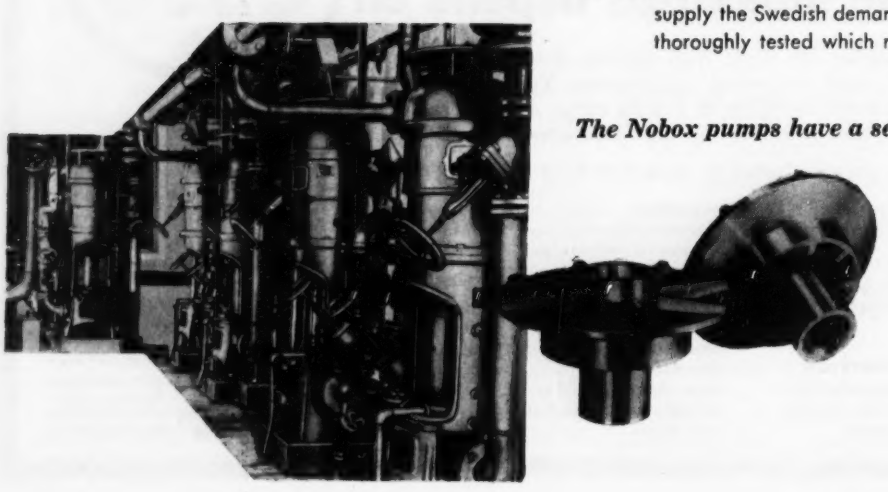

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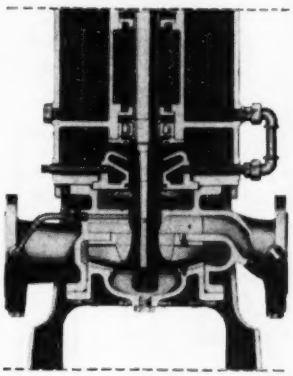

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To the employees engaged in the chemical industry, who know all about the enormous difficulties involved in carrying corroding and eroding liquids, the qualities of the Nobox centrifugal pumps will mean an entirely new basic point from which to plan the operation. We should be glad to mail detailed information and also would appreciate it if a personal call by our representative could be arranged.

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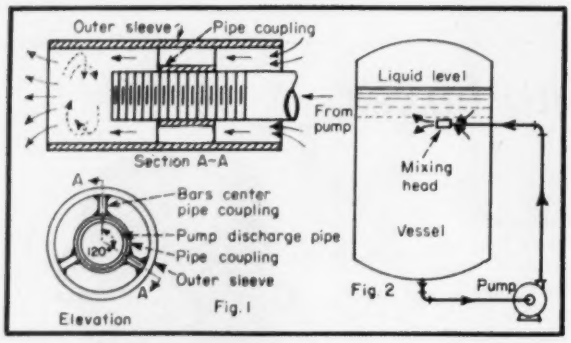


Simple Venturi Jet Adds to the Efficiency of Pump Mixing

STANLEY YOKELL, *Chief Engineer, Process Engineering & Machine Co., Elizabeth 4, N. J.*

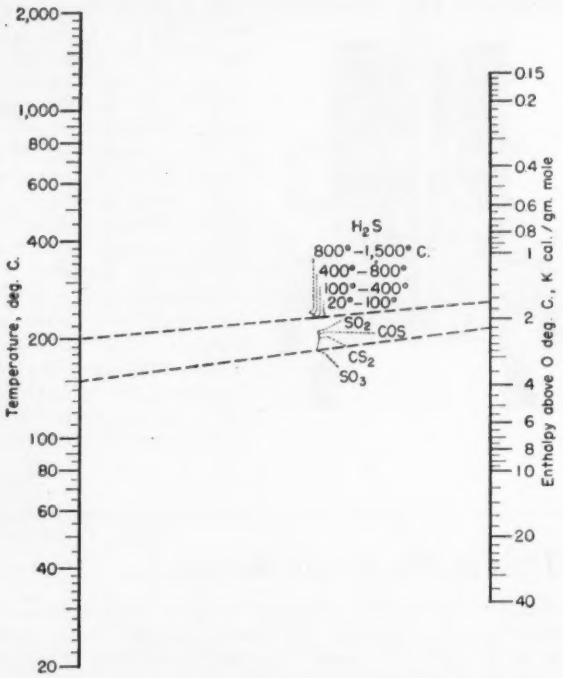
★ **January Contest Prize Winner**

A common method for full fluid mixing of the contents of a tank is to fit the vessel with a recirculating pump which draws suction from the bottom and discharges into the top.

This method has the inherent disadvantage of not directly applying the energy supplied by the pump to the bulk of the batch, but rather only to the portion flowing through the pump. Thus, where materials of large density difference are to be mixed, it is possible to circulate the denser material and yet accomplish very little mixing with the less dense mass. Caustic washing of chlorinated benzol is such an application.

A simple method of increasing the efficiency of pump mixing is to take advantage of the flow energy of the discharge stream of the pump by making a simple venturi type mixer out of pipe, fittings and material usually available in the maintenance shop.

Fig. 1 illustrates such a device and Fig. 2 illustrates its application schematically. The pump discharge enters at a point below the surface of the tank contents. A sleeve made from a section of pipe is supported on a spider made from a coupling and three pieces of flat stock. The discharge is threaded for a portion of its length to allow for adjustment of the sleeve position. The position of the sleeve is adjusted to give the maximum mixing effect. Material from the batch is drawn into the rear of the sleeve and emerges from the mouth thoroughly mixed with the pump discharge stream.



Nomograph Gives Accurate Estimates of Enthalpies of Sulfur Compounds

D. S. DAVIS, *Professor of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va.*

The accompanying line coordinate chart enables convenient and accurate estimates to be made of the enthalpies of five sulfur compounds above 0 deg. C. The use of the

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☆ **February Contest Prize Winner**

"Simple Way to Improve the Operation of Hot-Air Shelf Dryers."

A prize of $50 in cash will be awarded to P. I. Johnson, chemical engineer, Naugatuck Chemical Div., U. S. Rubber Co., at Naugatuck, Conn. Mr. Johnson's article will appear in the May issue.

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Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

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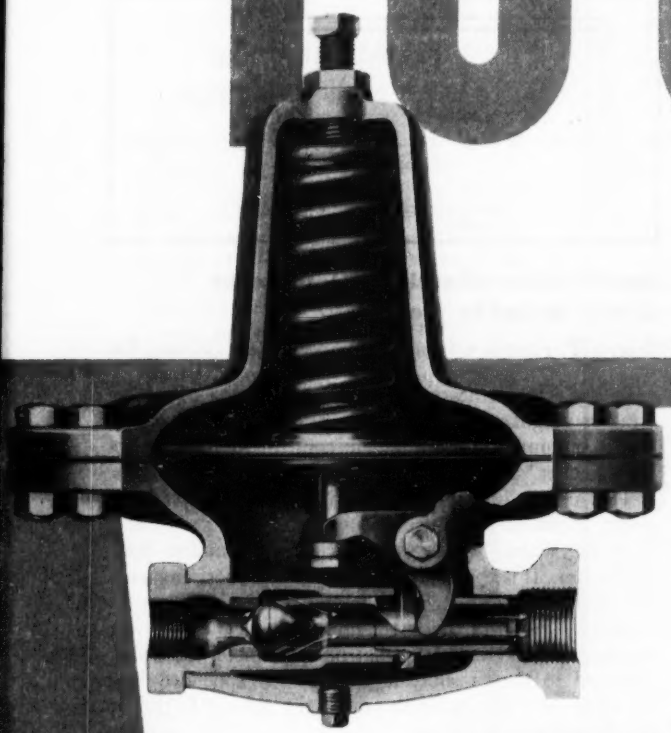

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A. W. CASH COMPANY

chart, constructed from the data of Kobe and Long (*Petrol. Refiner*, **29**, 126, Jan. 1950), is illustrated as follows: What is the enthalpy above 0 deg. C. of 1 mole of sulfur trioxide at 150 deg. C.? Connect 150 on the temperature scale with the gage point for sulfur trioxide and read the enthalpy on the scale at the right as 2.2 K calories per gram mole.

Hydrogen sulfide requires the use of several gage points, depending on the temperature. What is the enthalpy of 1 mole of hydrogen sulfide above 0 deg. C. at 200 deg. C.? Connect 200 on the temperature scale with the gage point for hydrogen sulfide that is marked "100 — 400 deg." and read the desired enthalpy on the scale at the right as 1.66 K calories per gram mole.

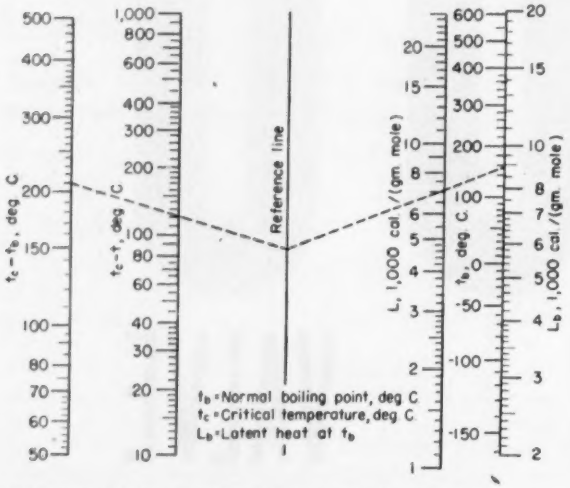
$t_c - t_b$, deg C
$t_c - t$, deg C
Reference line
L, 1,000 cal./(gm. mole)
t_b, deg C
L_b, 1,000 cal./(gm. mole)
t_b = Normal boiling point, deg C
t_c = Critical temperature, deg C
L_b = Latent heat at t_b

Chart Aids Estimation of Latent Heats of Vaporization

ROBERT LEMLICH and RONALD HOKE, *Department of Chemical Engineering, University of Cincinnati, Cincinnati 20, Ohio.*

Through the combination of several existing relationships, the latent heat of vaporization for different substances at various temperatures may be estimated by means of the accompanying nomograph.

For a particular substance the heat of vaporization at one temperature may be estimated from that at another temperature by means of Watson's equation,[3] or $L/L' = [(1 - T/T_c)/(1 - T'/T_c)]^{0.38}$, where T_c is critical temperature in deg. K., T and T' are temperatures in deg. K., and L and L' are latent heats in calories per gram mole at T and T' respectively. When the latent heat is not known for any temperature it may be estimated for non-polar substances at the normal boiling point by the Kistiakowsky equation,[1] or $L_b = T_b\,(8.75 + 4.571 \log_{10} T_b)$, where T_b is the normal boiling temperature in deg. K. and L_b is the corresponding latent heat in calories per gram mole. The errors for these relationships are reportedly generally less than 5 and 3 percent, respectively. Thus, with these two equations the latent heat for non-polar substances at any temperature may be estimated knowing only T_b and T_c. If T_c is not available it may be approximated by Guldberg's relation, $T_c = 1.5\ T_b$, or estimated more accurately by Meissner's method.[2]

Use of Nomograph—Temperatures on the chart are in deg. C., not deg. K. For polar substances connect from $t_c - t_b$ through $t_c - t$ to the reference line; then connect to L_b, giving L by intersection. If L_b is not known, the latent heat at any other temperature may be used instead by simply substituting this known latent heat for L and substituting its corresponding temperature for t_b. Thus only a single known latent heat is required in order to predict all others. For non-polar substances the same procedure applies. However, when for such substances no latent heat data are available at all, connect from the reference line to t_b since the right-hand axis directly relates L_b to t_b for non-polar materials.

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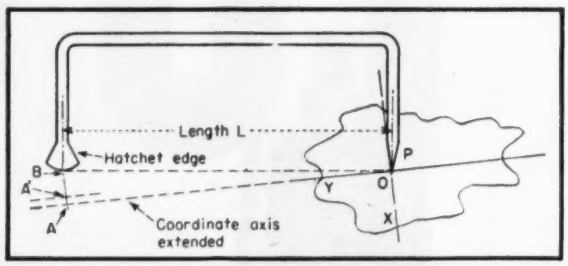


Home-Made Hatchet Planimeter Gives Reliable Results

JOSEPH T. HOGAN, *Chemical Engineer, New Orleans, La.*

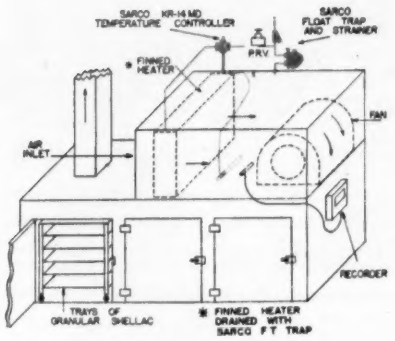
Ballard's recent description of a method for estimating areas of irregular shapes (*Chem. Eng.*, **60**, p. 234, Sept. 1953) prompts me to bring the construction and use of the "hatchet" planimeter to the notice of fellow engineers.

This device is very simple and inexpensive, yet gives results in the measurement of areas which are comparable to those achieved with the much more familiar polar planimeter. It is comparatively unknown to most engineers and draftsmen, although it is not new, having been invented by Pryzt[1] in the last century. Publications on the construction and use of the hatchet planimeter are widely scattered so that a short bibliography is appended here for those who may want to pursue the subject further in the literature.

A hatchet planimeter in its simplest form consists of a metal rod, approximately ¼ in. in diameter, bent twice at right angles to form a long arm about 10 in. long, with two short arms about 3 in. long.[2] One arm is sharpened to a point P, and the other to a convex knife edge or hatchet edge (hence the name hatchet planimeter) in line with P. The knife edge, the center line of the rod, and the point P should lie in the same plane. The author has at times used ⅜ in. curtain rod for construction of planimeters as described above. The planimeter, when arranged as shown in the sketch, is ready for use.

The outline of the figure whose area is to be determined

Misused steam plays havoc with production schedules and costs



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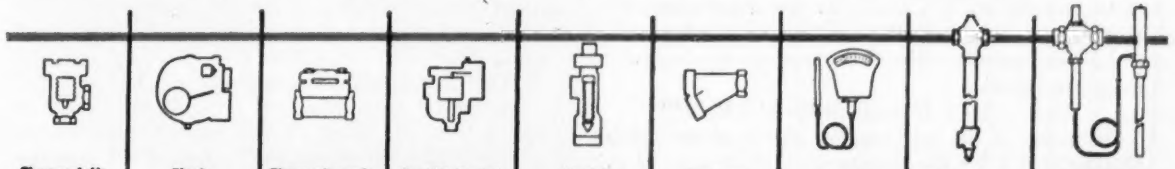

Thermostatic Steam Traps | Float-Thermostatic Steam Traps | Thermodynamic Steam Traps | Camlift Bucket Steam Traps | Liquid Expansion Steam Traps | Strainers | Electric Temperature Controllers | Water Blenders | Self-Operated Temperature Controllers

is placed on a sheet of drawing paper. To determine the area proceed as follows:

1. Mark the approximate center of the area, *O* (center of gravity), and through this point draw the coordinate axes, *OX* and *OY*, intersecting the perimeter as shown.

2. Stand the instrument on its legs so that the hatchet edge rests on one of the coordinate axes extended, point *A* in the figure, and the point *P* rests on point *O*, the center of the figure. Holding the instrument upright and lightly grasping the arm resting on *O*, pass from this point along the line *OX* to the perimeter of the figure at *X*, using the point *P* as a tracing stylus. Still holding the instrument, proceed to trace along the perimeter in a *clockwise* direction until you again reach *X*. Then retrace along *XO*, completing the operation at O. During this operation the knife edge or hatchet edge will have moved back and forth in a fashion depending upon the configuration of the perimeter and will have moved a distance equal to *AB*. Mark *B* by pressing lightly on the leg having the hatchet edge. Measure *AB* using a scale graduated in hundredths of an inch. The product of the length of *AB* in inches and the length *L* of the instrument gives the approximate area in square inches. Knowing the scale of the drawing, the area it represents can then be calculated by a simple conversion.

3. To check the accuracy of this procedure, when the tracing point *P* arrives back at *O* after having traced the outline of the figure, the above procedure can be repeated with the hatchet edge resting on the point *B* and the tracing of the perimeter made in a *counterclockwise* direction. When the pointer finally arrives at point *O* by tracing along *XO*, if the first operation was without error, the hatchet edge should rest on point A. In the event of any discrepancy, the hatchet edge will rest on some other point *A'*. The distance *BA'* should then be measured and the average of *AB* and *BA'* be used as a multiplier of the length *L*.

A certain amount of technique is necessary for accurately tracing the figure. Practice in tracing various shapes and patterns will develop the skill necessary for attaining accuracy in the use of the instrument. The tracing arm should be lightly held in the fingers to permit freedom of movement, thus preventing the operator from influencing the motion of the hatchet edge. The hatchet edge should be honed free of any rough edges.

The beginner can inspire confidence in himself in use of the planimeter by tracing the perimeters of regular geometrical shapes whose areas can be calculated. For each determination of area the planimeter arm *L* should be accurately measured.

Actually, the distance *AB* [or $(AB + BA')/2$] represents a chord of a circle of radius *L*. The true area of a traced figure is given by the product of length *L* and the arc of the circle of radius *L* which is subtended by the chord *AB*. For small displacements of the hatchet edge the length of the chord and the arc it subtends do not differ appreciably. However, for large displacements, the arc and chord differ and a more accurate value of the area can be obtained by using the formula

$$\text{Area} = 0.070\ L^2 \arcsin\ [(AB + BA')/2L]$$

Discussion of the mathematical theory of the hatchet planimeter is a bit too lengthy for a short note of this kind but it has been thoroughly treated by others elsewhere, for example, Refs. 5 and 9.

This simple instrument is quite useful for the determination of area and when properly used gives results comparable to the more expensive forms of planimeters manufactured for sale. Results attained with the hatchet planimeter are subject to the same errors in tracing that exist in the use of the polar planimeter. Human errors of this type are minimized by retracing as outlined in the third step above.

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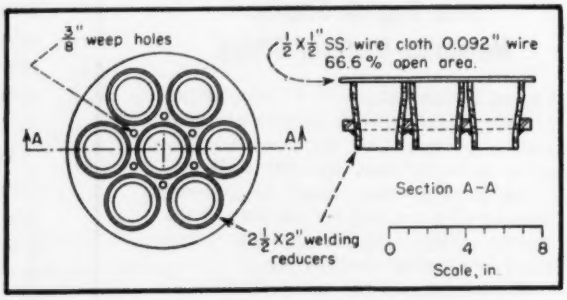

Welding Reducers Make Improvement In Packing Support Plate

J. L. Honnold and M. P. Sweeney, *Process Engineers, United Engineers & Constructors, Inc., Philadelphia 5, Pa.*

Proper design of a packing support plate for packed towers is very important in obtaining optimum tower operation. The following are qualities which a well designed packing support plate should have:

1. The plate should be structurally strong.

2. The support plate should redistribute the down-coming liquid where there is another packed section below it in the column.

3. In operation, the support plate should have a low hydrostatic head in order to reduce pressure loss across the plate itself.

4. It is desirable to have a support plate with a percentage free area comparable to that of the packing itself. This prevents large pressure drops and column flooding before the packing itself would normally flood.

5. The plate should be inexpensive.

Conventional packing support plates have from 20 to 30 percent free area and this is often reduced to an effective free area of 10 to 20 percent by blockage of the openings by the packing. Furthermore, when the down-coming liquid and rising gas must pass through the same opening,

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the liquid level on the plate must build up until the hydrostatic head of liquid equals the pressure drop of the gas across the plate. Obviously, this gives high pressure losses and the tower will flood far below the packing flooding point, thus seriously limiting the tower capacity.

A recent process required three packed sections in a 10-in. tower. For this application we designed the improved packing support plate shown above. The support plate is easily and economically fabricated from welding reducers wedged or tack-welded in holes drilled in the support plate. Wire-mesh screen is placed over the tops of the reducers to hold the packing. Liquid drainage from the tray is provided by small weep holes. Since the gas will pass through the reducers, a minimum number of weep holes is required for liquid drainage. The weep holes are near the center of the plate to redistribute the liquid which tends increasingly to flow down the walls as it passes through packed sections.

The plate design shown in the sketch is structurally strong since only 40.1 percent of the plate is removed for reducers and weep holes. At the bottom of the reducers, 29.8 percent of the column area is available for dry gas flow. At the top of the reducers, 42.5 percent of the column area is available for gas flow into the packing (compared to 20 to 30 percent for normal support plates). Since gas and liquid do not have to pass counter-currently through the same opening, a negligible hydrostatic head and pressure drop is encountered across the plate.

Inner Tube Starts Weighing Controversy

What's the Answer?

In January (p. 230) we reprinted David H. Gieskieng's August Plant Notebook Contest winner, this time as the winner of the 1953 annual prize. Reader A. E. Myers immediately produced a mathematical analysis which showed that Mr. Gieskieng's inner-tube scale could not have a linear calibration as claimed in the article. Mr. Gieskieng replied that he had proved the calibration linear in many tests, despite the evidence of the mathematical analysis. He had, in fact, originally believed that linear calibration would be impossible—for the same reasons brought out by Mr. Myers.

Why, then, does it work? Below we give you Reader Myers' analysis, together with Author Gieskieng's reply. Does the mathematical analysis miss at some point? Is the departure from linearity so small as to be imperceptible. We'll welcome comment, especially the answer.—TRO

Mathematics Says "No"

Sir:

The inner-tube weighing device described by David H. Gieskieng on p. 230 of your January 1954 issue is an ingenious device, which is also easy to assemble. However, it does not seem possible that its calibration can be linear as stated in the article. Equal increments of weight in the container could produce equal increments of pressure in the tube only if the area of the platform or container in contact with the tube remained constant. This is not the case, since the tube is progressively flattened in contact with the platform as weight increments are added to the container. This means that the contact area must increase with the weight.

Stating it mathematically,

$$W = P \times A$$

where W = weight on the tube, P = pressure in the tube, and A = area of tube in contact with the platform.

Since both P and A increase with an increase in applied weight, neither P nor A can vary linearly with W.

This is obviously not the same situation we would encounter if the weight were supported by a piston of constant area. In that case pressure increase would be linear with the weight increase.

A. E. Myers
Special Products Dept., Shell Oil Co.
New York 20, N. Y.

Experience Says "Yes"

Sir:

I am very glad Mr. Myers has commented on the linearity of the inner-tube scale because it raises a question which has as yet not been answered, so far as I know.

Actually, for some unanswered reason, the inner-tube scale does give results which are quite linear. Use of this device was first considered for making about 150 laboratory tests. In these it was necessary to obtain a continuous record of the weight of product passing through small jaw and cone-type crushers. In considering the possibility of using an inner tube as indicated, we felt that the calibration would not be linear. In fact, I even considered using several hot water bottles sandwiched between two plates to minimize the "area" variation.

However, the inner-tube idea was tried out and found to give linear results. It was satisfactory up to a total load of at least 150 lb. In most of these tests, about 50 lb. of sample was run, with all the test data including weight, crusher speed, power consumption, and the total number of revolutions of the crusher recorded by means of a synchronized motion picture camera.

Slight changes in calibration occurred from run to run, due either to stretching of the rubber, to slight temperature changes in the inflating air, or to disturbance of the apparatus while handling the sample. However, these changes did not affect calibration during a test. These test measurements showed consistent linearity when plotted, regardless of the fact that the tests were of various durations, which precluded a balancing of non-linear effects. Furthermore, in a later series of similar tests made with a mechanical recording scale, essentially similar results were obtained.

Bearing on the versatility of the inner-tube scale, we used it in two installations where there was insufficient room to use the inner tube in its normal doughnut shape. Here, it was necessary to force the tube into an oblong shape between restricting timbers. In another case, a wash tub was placed directly on the inner tube, and in still another a box, without benefit of a platform. In none of these abnormal cases, involving samples to 60 lb., was the linearity of response upset. This was interesting also because neither wash tub nor box completely covered the inner tube.

D. H. Gieskieng
District Office,
Allis-Chalmers Mfg. Co.
Denver, Colo.

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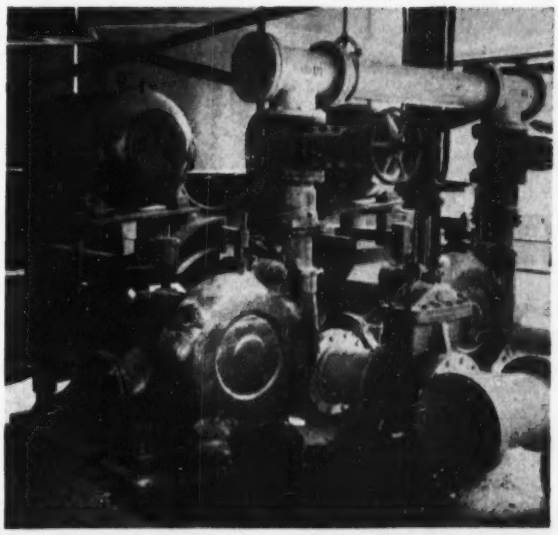

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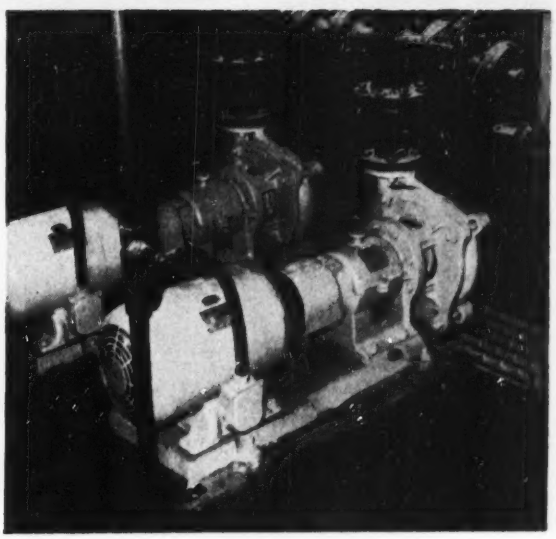

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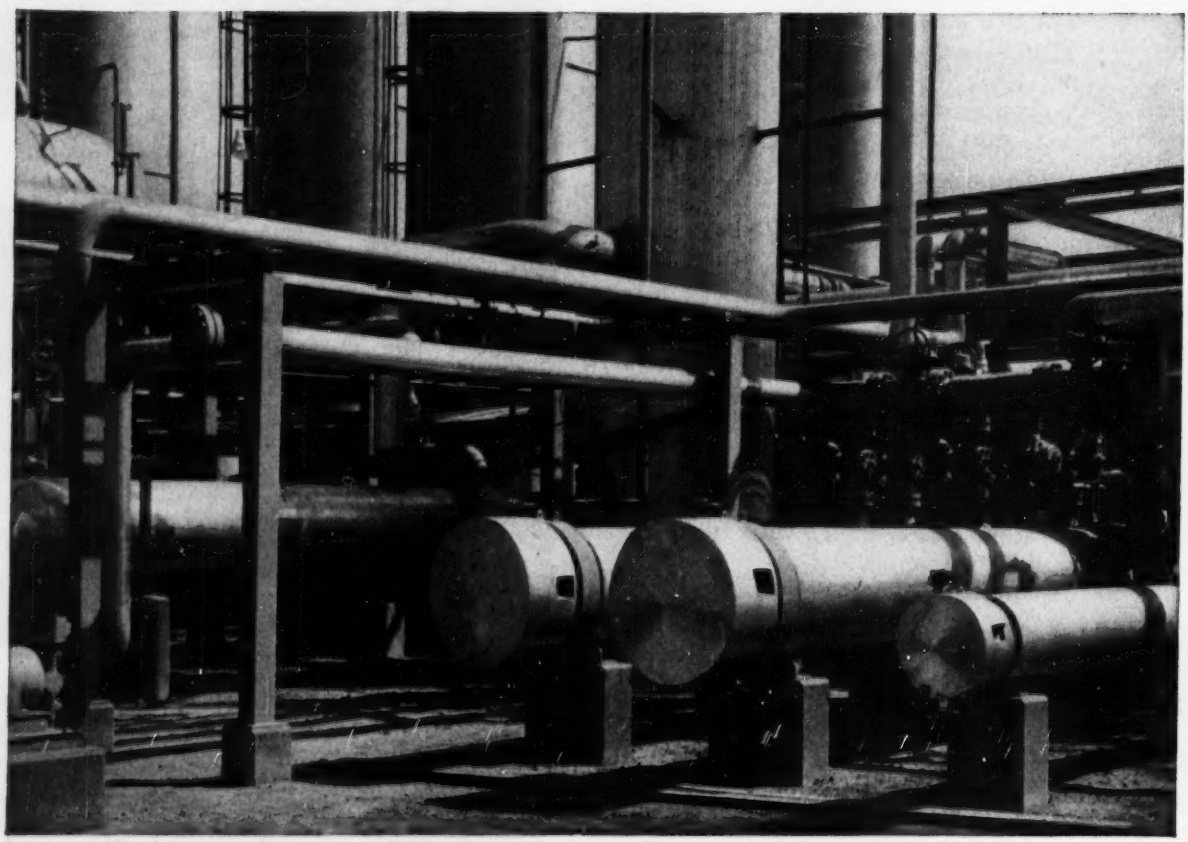

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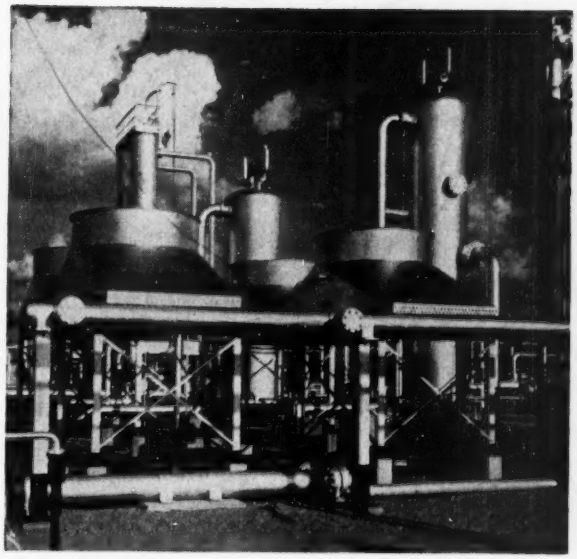

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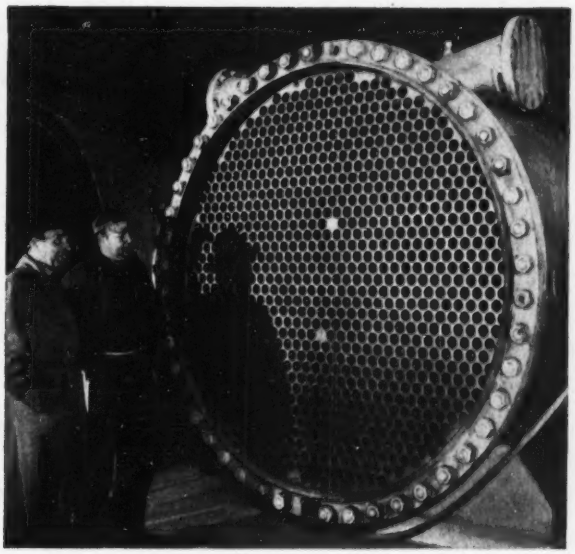

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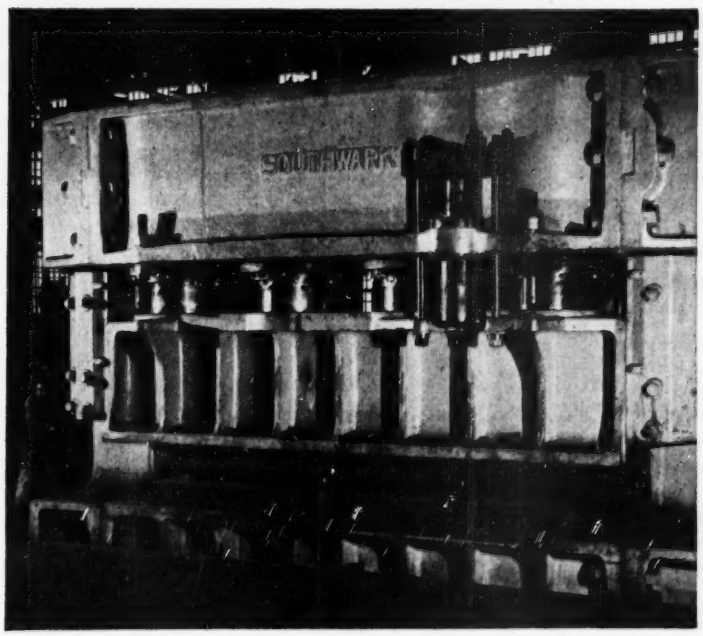

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How to Reach the Top . . .
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The smoke hung heavily over the conference table.

Charlie Carter, plant superintendent, had the floor, "I guess that does it," he was saying, "we'll give Frank Slaughter the chance to head up the maintenance group. Any further comments? Jack? Paul?"

Jack Roth, personnel manager, stopped toying with his cigarette lighter, "Okay by me. Frank's been here five years now. Got a fine record, too. How about you, Paul?"

Frank's boss, the chief engineer, Paul Miller, cleared his throat, "I'm for it. Frank's one of the best engineer's I've got. I think he deserves the promotion. He'll do a damn good job."

"Well," said Charlie, "that wraps it up. Frank's our man. I'll take care of the announcement and the other details. Thanks a lot for your help and advice, fellows."

That's how it went. Frank took over, pleased as punch with his promotion. He piled right into the job and worked like a demon—gave it all he had. Funny thing though, he hadn't been in the job but a couple of months when it became evident that maintenance costs were soaring—far beyond reasonable estimates. There were rumblings of discontent in the group. And, when old Pete Callen, section foreman, up and quit, a terrific morale problem came to light.

The whole problem was laid right on the doorstep of the new boss. No doubt about it, Frank Slaughter just couldn't handle the men. With some he was gruff, overbearing. Others were his favorites. None had much respect for his leadership.

The result: Frank was encouraged to look for a job elsewhere, and a new man was brought in. Paul Miller felt pretty bad about it. After all, Frank had been one of his best engineers.

Though this situation is hypothetical, the general problem is not. It has occurred again and again in every type and phase of industry.

BOSSES ARE SORELY NEEDED

Developing competent executives is one of the major problems of management.

This great manpower shortage and talent hunt which you've heard so much about actually has two distinct phases:

- Young, just-out-of-college engineers are, and will continue to be, in short supply.
- Older, more-experienced men, now ready to fill management posts, are also hard to come by.

While the former gets the biggest play in the press, the latter is every bit as serious, every bit as vexing to management. That's the reason for today's fuss over

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executive development, and its aftermath of consultants, courses and handbooks.

Just about all of the larger companies, and plenty of the smaller ones have developed some sort of set-up to teach selected employees the art and science of management.

Other organizations, such as the American Management Association and the various independent management consulting groups, set up and conduct courses which touch on every phase of management, from leadership to budgeting.

Many organizations, the AIChE and the American Pharmaceutical Manufacturers' Association are two, have devoted sessions of annual and regional conventions to various management problems. These sessions have often been among the best attended of the convention.

The National Association of Manufacturers, in an effort to tackle the problem at the ground level, has distributed literature to the high schools. They stress the fact that management is rapidly becoming almost a profession unto itself, and that no matter what branch of industry you enter you can aim yourself in the direction of management—and help yourself get there.

OPPORTUNITY IS BECKONING

As technology becomes more complex, more engineers are needed for executive posts.

Specialization has been the watchword in industry for years. A man is hired to do a specific job—the one for which he is best fitted—and that's it. When a promotion comes to him he may suddenly find himself expected to do a job for which he has no real aptitude. Frustrations, tensions, ulcers are all too often the result.

But industry has discovered that as technology becomes more complex the administrator not trained technically works under a growing handicap. The result: A definite trend toward the selection of engineers for executive posts.

However, just as a good ditchdigger may be a poor boss of other ditchdiggers so a good engineer is not necessarily a good executive. Managers are made, and mostly self-made, not born.

Rate Yourself Against These Qualities

All of these qualities are part of the executive make-up. Now take a look at yourself. See how you measure up. If you have them, or if you're willing to develop them, you stand a pretty good chance of success and satisfaction in a top job.

- **Achievement-minded**—Needs problems, challenges—finds them stimulating. Happiest when accomplishing.
- **Convincing**—Uses language effectively, is able to put ideas over and have them accepted by others.
- **Decisive**—After studying the facts will take a stand. Sticks to it, but isn't stubborn if proved wrong.
- **Diversified**—Dislikes details and routine. Has broad interests, generalized knowledge and skills.
- **Down-to-earth**—Pragmatic, practical, cost conscious. Interested in things primarily from the use angle.
- **Driving**—Has lots of ambition, a competitive spirit. Wants material rewards and greater job prestige.
- **Hard-working**—Enjoys the stimulus of hard and difficult work. Willing to spend the required time on it.
- **Inspiring**—A leader, able to plant confidence and enthusiasm in others, guide them over rough spots.
- **Mature**—Grown-up, not addicted to pettiness or hopping to conclusions. More rational than emotional.
- **Visionary**—Imaginative, sees behind immediate problems and goals, thinks "big," doesn't fear failure.

Whether your company has a program to develop executive talent or not, just how far you travel up the ladder depends largely on you.

First off, the most important thing to determine is "Do I really want an executive job?" Plenty of times the answer will be "No!"

Top personnel men tell us that it is astounding to note the number of employees who will deliberately refuse responsibility, even turn down promotions, if the post offered involves supervising the work of others. Others will reject a management job simply because they're content doing their present job, and wish to stay out of "Ulcer Gulch."

Remember, being the boss is no snap. Sure it pays better, but it also means being on tap 24 hours a day. Night work and working on weekends will sometimes be necessary and can even become routine. And don't forget, heavy travel is often involved.

In addition, when the men in your charge have questions they'll want answers. You'll be the guy they'll ask and you'll have to have the answers.

On the other side of the coin, there are lots of reasons for going after that administrative job.

The pay is generally better. Pay structure of executives has been likened to a truncated pyramid surmounted by an obelisk. You'll find the big money in the obelisk.

There's more to it than that, though.

The man at the top has the personal satisfaction of being at the top, of having achieved something. Recognition of this by others is one of the prime compensations of an executive post.

He has the chance to work with broad problems, bigger challenges. No longer is he tied to handling details. Routine, too, is a thing of the past. New problems, new

consider:

Corrosion Resistance and Analyses

As chromium and nickel provide corrosion resistance in stainless steel, it follows that 18-8, 18-8 Cb, 18-8 ELC and 18-8 Ti, having similar chromium and nickel content, should have the same corrosion resistance. Exposure in certain types of service, however, may prove otherwise.

If tubing of these materials is field welded without subsequent heat treatment, or operated intermittently at high temperatures, there will be a difference in corrosion resistance. The 18-8 grade may lose its corrosion resistant properties while the other three grades maintain theirs. This is because of slight differences in chemistry—5 parts in 10,000 in carbon content or the addition of 5 to 7 parts in 1,000 of columbium or titanium. Thus, your particular end use service condition, in addition to the basic cost of materials, should dictate which grade to use.

For virtually any application—pressure or mechanical—B&W can provide either seamless or welded stainless tubing in any number of grades, in a broad size range. Help in obtaining the best stainless tubing for your applications is available through B&W Regional Sales Offices and a nationwide network of experienced tubing distributors. Mr. Tubes—your link to B&W—will be pleased to furnish detailed answers to your stainless tubing problems.

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B&W SEAMLESS and WELDED TUBES

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ideas, new contacts come every day. These are stimulating and important to him.

The job is bigger, the rewards are bigger—it evens out. Some will not care for it; others will. You'll have to decide which group you belong to.

WHAT YOU HAVE TO DO

Measure yourself against the job. Then go after those qualities you lack.

If you do decide to go after that top job, you run into your second problem: how to get it.

First thing to do is to find out what the job calls for and what equipment you're starting out with—then you'll know what will have to be acquired. Fair enough?

WHAT MAKES AN EXECUTIVE?

Who's the best boss you know? What does he have? Five will get you ten if there isn't a mixture of technical knowledge, practical experience and the knack of handling people somewhere in his make-up. If he's good, they'll all be there.

Extraordinary intelligence? It may be a help, but it's not at all necessary. A top-notch executive may employ highly skilled men who will do a whole lot better than he will on certain types of intelligence tests, but generally the executive will know more about more things. His interests are broader, not channeled in one direction.

WHAT ARE YOU STARTING WITH?

As an engineer, you've already stolen a march on the rest of the pack in any drive for an administrative post. You've learned a method of thinking, which is well nigh unbeatable. It's been called the "engineering method."

By now, it's probably so much a part of you that you never even think about it. It consists simply of

- Gathering all available data, all the facts
- Analyzing them objectively
- Deciding upon the course of action indicated

It's all pretty obvious, isn't it. But then the obvious is often the best, and you'd be surprised at the small number of people who use this method.

It's the "engineering method" that keeps you from going off half-cocked when you meet a design or production problem in the course of your job. It will be one of your biggest assets in any type of work.

WHAT DO YOU NEED?

The higher you climb on the management ladder the less you'll be doing strictly engineering work. More and more your job will involve people. This will require a complete reorientation.

You'll have to be able to get along with people, to lead them, to arouse their enthusiasm. To do this effectively you must be able to get your ideas across to them. Debating, public speaking and writing courses are available almost everywhere and can be a big help.

In any event, you'll want to take advantage of every opportunity to speak or write that comes your way. You'll also want to increase your vocabulary, for the successful executive must be able to understand complex words—but use simple ones.

Look for opportunities to be a leader. When there's a job to be done, volunteer to do it. Soon you'll get into the habit of leading and acquire confidence in your ability—others will too.

Since there's no substitute for experience, getting experience will be one of your big problems. Once you've made up your mind that you want that executive job you'll have to begin broadening your interests. Take every chance you get to learn more about the business side of your company.

Good courses in economics and business administration will help fill in some of the gaps in your experience.

Don't overlook reading. Try to stay on top of the developments in the industry. Know what's going on. Good general reading, too, will help you get that cultural background that is so hard to put your finger on but is such a big help in dealing with others.

While going about preparing yourself for that bigger job, it might be a good idea to start in right now getting yourself noticed by the people who can give you that first, or next, promotion. The best way to do that is to build a reputation for doing your present job right.

In their quest for THE job, this is the step that trips so many would-be executives.

THESE CAN HELP YOU

"How Am I Doing?" by Robert F. Moore. B. C. Forbes & Sons, Inc., N. Y.

"The Technique of Executive Leadership" by James F. Bender. McGraw-Hill Book Co., N. Y.

"How to Win Friends and Influence People" by Dale Carnegie. Simon & Schuster, N. Y.

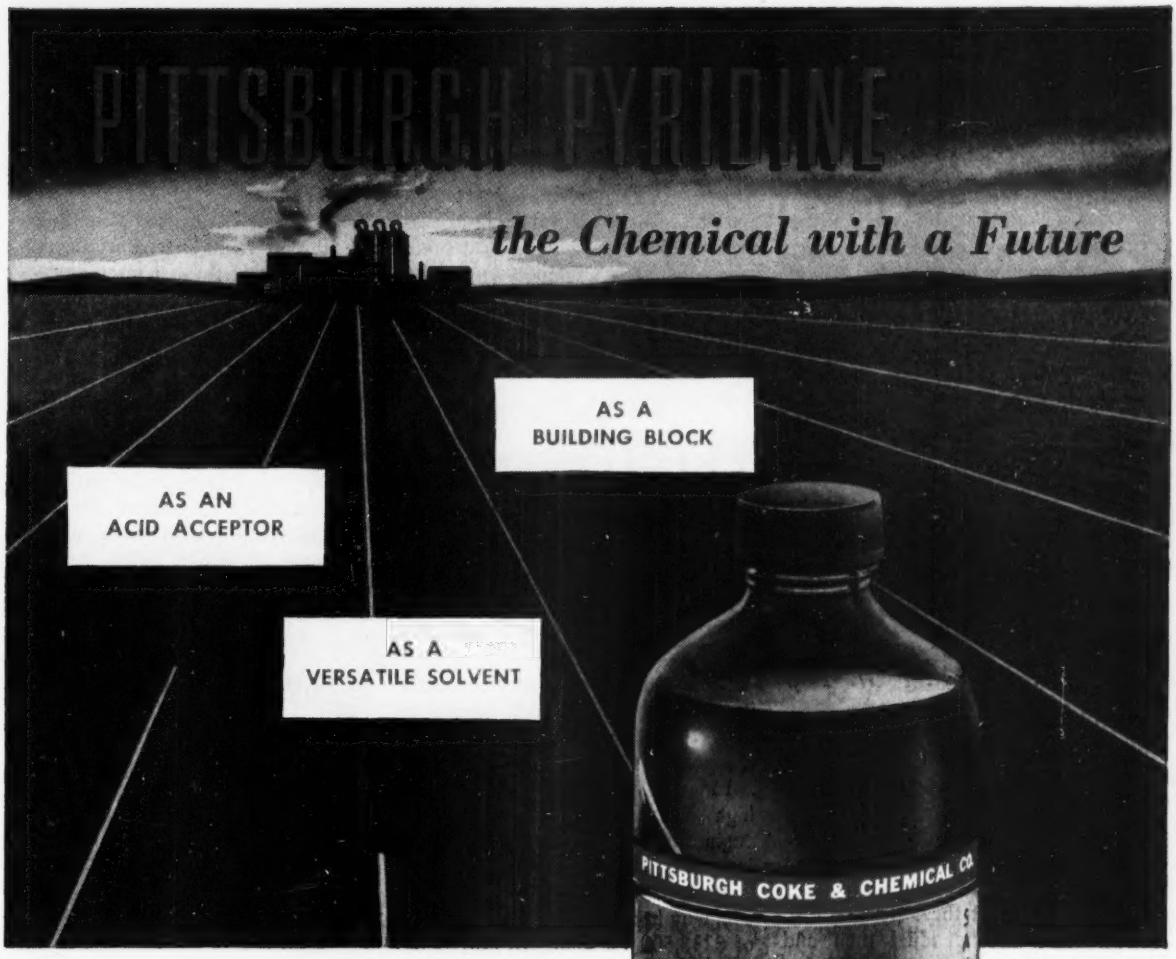
"How to Develop Your Executive Ability" by D. Starch. Harper & Brothers, N. Y.

"There's Plenty of Room at the Top" by Loire Brophy. Simon & Schuster, N. Y.

"What Corporation Presidents Think About at Night." John L. McCaffrey *Fortune*, Sept., 1953.

"Developing Engineers Into Executives." Robert F. Pearse, *Mech. Eng.*, Sept. 1953.

"How to Be Interviewed." Paul M. Stokes, *Factory Man. and Main.*, Nov. 1953.



How can you use it to improve your product or process?

Did you know that Pittsburgh Pyridine is an extremely valuable material for improving your pharmaceutical products and processes? Here's how it can work for you:

As a Building Block: Pittsburgh Pyridine's derivatives exhibit unusual biological activity, surface activity, and buffering activity as well as special adhesion and solubility characteristics.

As an Acid Acceptor: Pittsburgh Pyridine possesses remarkable acid accepting properties, but it will not affect many fine chemicals that might be attacked by caustic neutralizers.

As a Versatile Solvent: Soluble in both water and organic materials, Pittsburgh Pyridine produces cleaner separations and purer end products.

Pittsburgh Pyridine was used to produce some of the first sulfa drugs and vitamins. And, after a period of scarcity, it is again available in unrestricted quantities, largely because Pittsburgh has doubled its production. Pyridine is a material worth studying in *your* laboratory. Additional data and samples will be sent upon request.

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ENGINEERING DEGREES

. . . Due to Drop

Look for a drop this year in the number of men receiving bachelor degrees in engineering. Only 17,000 men will be graduated from accredited engineering schools this June. Last year, almost 22,000 were graduated.

Only bright spots in the situation are the growing graduate school enrollments, which indicate that more master's and PhD degrees will be awarded this year than last, and a slight gain in undergraduate enrollments.—*Engineering & Scientific Manpower Comm. Newsletter* #51.

EDUCATION

. . . Staying On Top

What people really need to keep them happy, is to feel that they are on top of life. This means being on top of their jobs; on top of their finances; on top of their problems.

If the manager, the department head, the superintendent, will study his people against these three human aspirations, as individual men and women, rather than as company employees, he may be surprised to find out how he can greatly help them.

Often people are submerged by their jobs simply because no one has taken the trouble to show them the best way to manage their work, so that they can keep on top of their jobs. We are apt to assume entirely too much in this respect. A little kindly interest, a few practical suggestions—and a load will be lifted.

While the employer has no right to dictate to his employees how they shall spend their money, there are areas in which a little friendly counsel will not be resented. This is especially true in helping people to work out plans for financing homes, new cars and other major purchases. Sometimes a loan can be arranged on easy terms, which will help the employee to keep on top of his finances.

Every worker has personal problems from time to time. Some small difficulty or worry looms large to the man or woman who keeps it bottled up inside. The manager who assumes that everyone in his department has at least one problem that is worrying him or her, will not be far wrong. Without prying, he may be able to find ways to get his people to discuss their problems with him. Most problems respond to common-sense solutions. Whether there is a ready solution or not, getting any problem out in the open lifts part of the load off the mind of the worrier.

These three areas of human need are worth constant study by all in management positions, from the president of the company down to the shop foremen.—*Management Briefs*

INDUSTRY TARGET

. . . Better Teachers

More and more, industry is turning its attention to the high schools as part of a long-range plan to alleviate the present shortage of engineers.

Industry leaders believe that better high school science teachers will spur engineering college enrollments, thus increasing the supply of engineers.

With this in mind, the Du Pont company has recently set aside a fund of $238,500 for grants to universities and colleges to aid them in training science teachers. This is a new addition to the company's program of aid to education and is the result of an experimental plan announced last year. Recognizing the need to improve high school science teaching, the company has made the advancement of teaching the largest single part of its aid-to-education program.

Aim of the new program is two-fold.

- Encourage college students to enter the field of high school science and mathematics teaching.
- Encourage teachers already in these fields to improve their effectiveness.

STARTING SALARIES

. . . Up for NYU Grads

NYU's 1953 engineering graduates started working at salaries that averaged 5 percent more than in 1952. Average starting salary was $345 a month, with the majority of the engineers taking jobs in private industry.

"Salaries of 1953 graduates ranged from $270 to $412," said Dean Thorndike Saville of NYU's College of Engineering.

The increase, he noted, continued the upward trend in engineering salaries of each of the last seven years—with the exception of 1949. Current starting salaries are up 52 percent over 1947's average of $227.

Some 71 percent of the engineering grads took jobs in private industry. Only 9 percent took civil service jobs. These were mostly civil engineers. About 15 percent of the graduates went into full-time graduate study.

Dean Saville pointed out that more companies than ever before took up campus recruiting in the competition to attract men.

SLEEPING REPORTS

. . . Or Dead Ones?

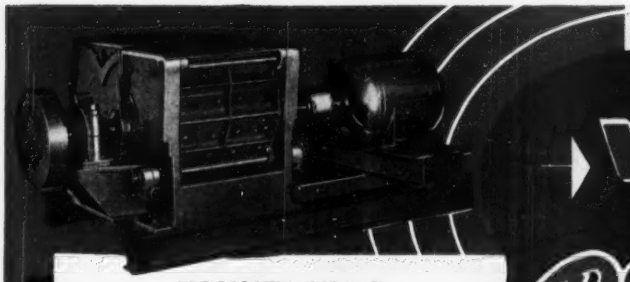
One of the criticisms we hear often, in the lower levels of organization, is that top management executives call for studies and reports which involve an enormous amount of work—"and then let them die," as one disgruntled department head complained recently.

Sometimes, of course, these special projects do "die,"; but more often they have to be held for an executive council or board meeting, or put aside for the time being for one reason or another.

In either case, it would make for better feeling if the top management official who asked for the special report would take the trouble to keep those who worked on the study informed of what is happening to it. There is no surer way to win the loyalty and interest of those down the line in an organization, or to insure that they will put their hearts into future projects. Conversely, to seem to let the report "die" is the surest way to breed cynicism and create a don't-give-a-damn spirit in an organization.

As you know yourself, there are few things more frustrating than the feeling that your efforts are ignored.

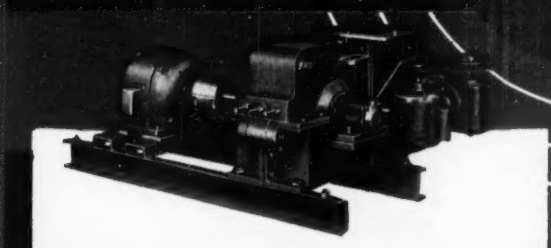
We might all ask ourselves with profit whether there are any sleeping reports in our desk drawers now that have never been adequately explained to those who worked them up with such pains.—*Management Briefs*



WILLIAMS has the Right Answers to all your GRINDING, CRUSHING, SEPARATING PROBLEMS

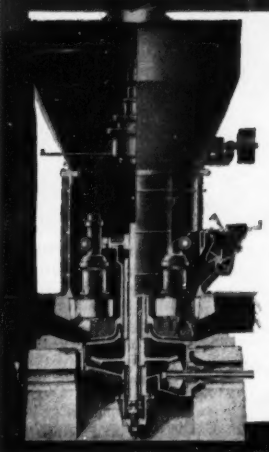
HAMMER MILLS

A size for every purpose! Williams Hammer Mills are designed to do the **complete job in a single operation.** No primary or secondary crushers required—extra foundations, conveyors, other expensive equipment are eliminated—thus saving as much as 75% on initial investment and up to 50% on grinding costs!



HELIX-SEAL HAMMER MILLS

Combines the advantages of a hammer mill with screw-type feed to obtain finenesses from 100 to 325 mesh. For dustless, cleaner, safer dry grinding—accurate, non-clogging reduction of sticky and wet materials. Eliminates separators, fans and cyclones. Furnished with water or steam jackets.



ROLLER MILLS WITH AIR SEPARATION

Pulverizes and blends with exceptional accuracy down to 400 mesh or micron size. Dries as it grinds. Instant size adjustment—automatic self-adjusting feed—many other exclusive features that mean improved quality and output.

Whether your job demands crushing power shovel-loaded stone to 8 mesh or smaller in a single operation—whether it is pulverizing or blending, with or without air separation, of limestone or insecticides to finenesses down to 400 mesh, or even micron sizes—whether it is closed-circuit dustless dry grinding, or the grinding of wet and sticky materials to 325 mesh—there is a Williams "proved-in service" machine that can give you **A BETTER PRODUCT—FASTER PRODUCTION—and LOWER COSTS.**

It will pay you to get the facts about Williams equipment, and learn what it can do for your specific operation. **Write Today For Literature.**

Send Us Your Questions

Complete testing and research facilities are maintained by Williams to develope the **right answers,** especially for your operation, on every size reduction problem. Write for information and the help of an experienced Williams technician.

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CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST BUILDER OF HAMMER MILLS IN THE WORLD

"Tube up and forget it" with leakproof Parker *Triple-lok* Fittings

Cramped and crowded, nobody likes to do this kind of a job over again. That's why trouble-free Parker *Triple-lok* fittings were used. Since this hydraulic test stand was completed, it has run over a billion impulse cycles at 3000 psi. without a single leak at any *Triple-lok* fitting.

These flare fittings are absolutely leakproof even under the severest conditions of vibration, high pressures and temperatures. Thousands of destruction tests prove that they will hold pressures that burst the tubing. And, they remain leakproof no matter how often you reassemble them!

Using *Triple-lok* fittings is also the easiest and fastest way to tube up your system even in close quarters. Flared tubing simplifies installation. For fitting make-up, you need only a small wrench because assembly torque is so low.

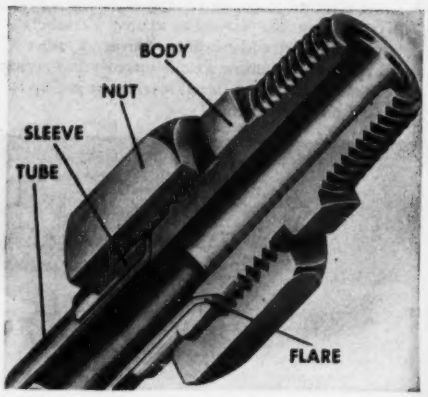
These fittings meet J.I.C. and S.A.E. standards plus specifications of the A.S.M.E. Code for Pressure Piping.

As a matter of fact, *Triple-lok* is the standard of industry. More *Triple-lok* fittings are used on industrial machinery than any other fitting.

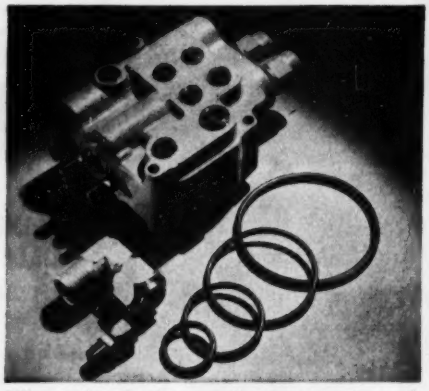
So, tube up and forget it. Use *Triple-lok* throughout your plant. Parker offers the widest range of shapes and sizes available . . . for tubing outside diameters from ⅛ through 2 inches. Ask your distributor for Catalog No. 4300.

TUBE AND HOSE FITTINGS DIVISION
The Parker Appliance Company
Section 4040, 17325 Euclid Avenue, Cleveland 12, Ohio

Parker
Hydraulic and fluid system components



3-piece Triple-lok fittings are stocked in steel, stainless steel, brass, and aluminum alloy —available in other materials on special order.



What other Parker products interest you? Ferulok flareless fittings? Hydraulic control valves? O-rings? Write Parker for information.

CALL YOUR NEAREST DISTRIBUTOR FOR PARKER INDUSTRIAL FITTINGS

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Baltimore 13, Md.	Carey Machinery & Supply Co. 3501 Brehms Lane
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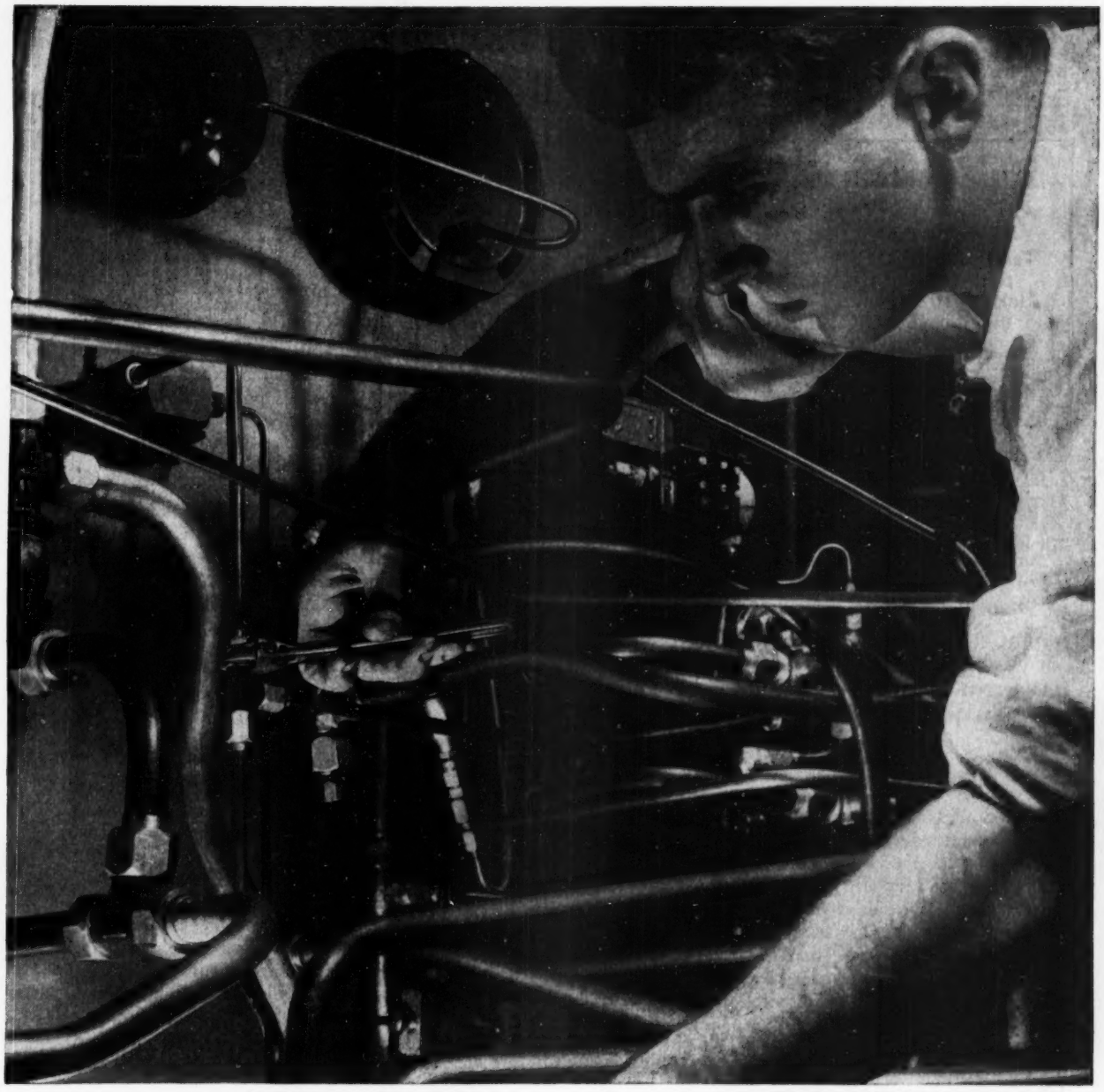
Beaumont, Tex.	Standard Brass & Mfg. Co 705 Milam St.
Birmingham, Ala.	Mill & Textile Supply, Inc. 3128 Third Ave. South
Boston 15, Mass.	A. E. Borden Co., Inc. 176 Brookline Ave.
Bryson City, N. C.	Wallace Co. of N. C. P. O. Box 572
Buffalo 7, N. Y.	Whitehead Metal Products Co. 2128 Elmwood Ave.
Cambridge 39, Mass.	Whitehead Metal Products Co. 281 Albany St.
Cedar Rapids, Ia.	Globe Machinery & Supply Co. 309 8th Ave. S. E.
Charleston, W. Va.	Persingers, Inc. 514 Elizabeth St.
Charlotte 1, N. C.	Industrial Piping Supply Co. 1501 Dowd Rd.
Chicago 14, Ill.	Wallace Tube Co. 1300 Diversey Parkway
Cincinnati 29, Ohio	Williams & Co. 3231 Fredonia Ave.
Cleveland 14, Ohio	B. W. Rogers Co. 1279 East 12th
Cleveland 14, Ohio	Williams & Co. 3700 Perkins Ave.
Columbus 8, Ohio	Williams & Co. 851 Williams Ave.
Dallas 9, Tex.	Metal Goods Corp. 6211 Cedar Springs Rd.
Davenport, Ia.	Globe Machinery & Supply Co 410 E. Second St.
Dayton 18, Ohio	J. N. Fauver Co. 1534 Keystone Ave.
Denver 2, Colo.	Metal Goods Corp. 2425 Walnut St.
Des Moines 8, Ia.	Globe Machinery & Supply Co. East First & Court Ave.
Detroit 1, Mich.	J. N. Fauver Co. 49 West Hancock St.
Harrison, N. J.	Whitehead Metal Products Co. 1000 South Fourth Ave.
Houston 3, Tex.	Metal Goods Corp. 711 Milby St.
Houston 1, Tex.	Standard Brass & Mfg. Co. 2018 Franklin St.
Indianapolis, Ind.	Avels Sales & Engineering Co. 16 W. 22nd St.



Easiest way to install tubing, even in cramped quarters, is to use Parker *Triple-lok* flare fittings. Assembly torque is so low that you need only a small wrench for fitting make-up. The self-aligning sleeve acts as a lock washer, supports the tube, and damps vibration. *Triple-lok* is absolutely leakproof even under high pressures and temperatures.

Jacksonville, Fla.	Florida Metals, Inc. 2937 Strickland St.
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Milwaukee 3, Wis.	Morman Belting & Supply Co. 522 W. State St.
Milwaukee 4, Wis.	Wallace Companies of Wisconsin, Inc. 838 South 6th St.
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New Orleans 12, La.	Metal Goods Corp. 432 Julia St.
Newport News, Va.	Noland Company 27th St. & Virginia Ave.
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New York 14, N. Y.	Whitehead Metal Products Co. 303 W. 10th St.
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San Francisco 3, Cal.	General Machinery & Supply Co. 1346 Folsom St.
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Shreveport, La.	Standard Brass & Mfg. Co. 1557 Texas Ave.
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TYPICAL CARBON-FILLED EPOXY CEMENT . . .

. . . Mechanical and Physical Properties

Tensile strength, psi.	3,000	Impact strength, Izod, ft.-lb./in.	3
Flexural strength, psi.	10,000	Adhesion to brick surface, psi.	700
Compressive strength, psi.	15,000	Linear shrinkage on curing, %	0.4
Specific gravity	1.3	Water absorption, %	0.1

Epoxys for Cements & Coatings

Although the proper role of epoxy cements is yet to be firmly set, their properties leave no doubt about their potential usefulness in corrosive applications.

RAYMOND B. SEYMOUR & ROBERT H. STEINER
The Atlas Mineral Products Co., Mertztown, Pa.

As a result of recent improvements, new cements based on epoxy resins have been introduced. These cements may be formulated with a wide variety of fillers which control the electrical conductivity and the density of the cured cement. Materials varying from excellent insulators to fairly good conductors are available. Some success in using filled epoxy resins as coatings has been obtained by blending of epoxy cements with epoxy resin based adhesives.

Epoxy resin cements show outstanding adhesion to almost all rigid materials including metals, ceramics, plastics and wood. Bonds with shear strengths greater than 300 psi. are readily obtainable without the application of heat or pressure through the use of these materials.

CHEMICAL RESISTANCE LIKE FURANES

The proper role of epoxy cements has yet to be determined. Their chemical resistance resembles that of furane cements at temperatures below 200 deg. F., except that epoxy cements are not as resistant as furane cements to warm alkaline solutions. Epoxy cements have excellent adhesion and, unlike furane or phenolic cements, will set in contact with portland cement or metals. The low shrinkage of epoxy cements is usually featured but actually modern furane, phenolic and epoxy cements do not differ appreciably in this important characteristic.

EPOXY COATINGS

Epoxy resins may also be used as room-temperature curing and high-bake coatings. While such coatings are not recommended for immersion service with highly corrosive materials, they are satisfactory for protecting mild corrosive liquids from metallic contamination and for general use for protection against splash and fumes of all types.

As might be expected, room-temperature setting compositions are less resistant to solvents than the high baked variety. Nevertheless, the room-temperature setting product is of considerable importance as a general purpose coating. Both types have excellent adhesion and resistance to impact and, like the epoxy cements, are resistant to both acids and alkalis.

The room-temperature setting coating is mixed with an amine type catalyst just before use. Compounding may take place in the can or at the spray nozzle through the use of a dual nozzle spray gun. Both high-bake and room-temperature setting type epoxy coatings should be applied on sand-blasted steel. The high-bake coating should be applied in multiple coats and baked at 350-400 deg. F. after a preliminary drying step at lower temperatures.

Epoxy resin coatings have been used as linings for cans, drums, tank cars, storage tanks and pipe. As indicated by the accompanying resistance tables, epoxy resin cements and coatings constitute a new chemical resistant material of construction that warrants consideration when the properties of standard resin cements and coatings are not adequate for the anticipated service.

While the data presented are based

(*Continued on page 246*)

About Other Plastic Cements . . .

The corrosion resistance of other plastic cements used for the joining of brick and tile as well as the preparation of cast plastic structures have been discussed previously (see Corrosion Forum, Dec. 1951, Jan.-March, 1952).

Briefly, furane cements are recommended whenever alkalis, corrosive salts, non-oxidizing acids and/or solvents are present at temperatures up to 375 deg. F. Phenolic cements are less widely used because of their inherent lack of resistance to alkaline media. However, phenolic cements are somewhat more resistant than furane cements to mild oxidizing agents.

Plasticized sulfur cements are more resistant than phenolic cements to oxidizing agents. Since sulfur cements are applied as hot melts, they are sometimes preferred for acid service at temperatures below 200 deg. F. Silicate cements will withstand higher temperatures and most oxidizing agents at pH's below 7. They must be used when hot concentrated sulfuric, chromic or nitric acids are present but because of their high water absorption, are seldom recommended when any one of the previously mentioned cements is satisfactory.

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corrosion resisting equipment

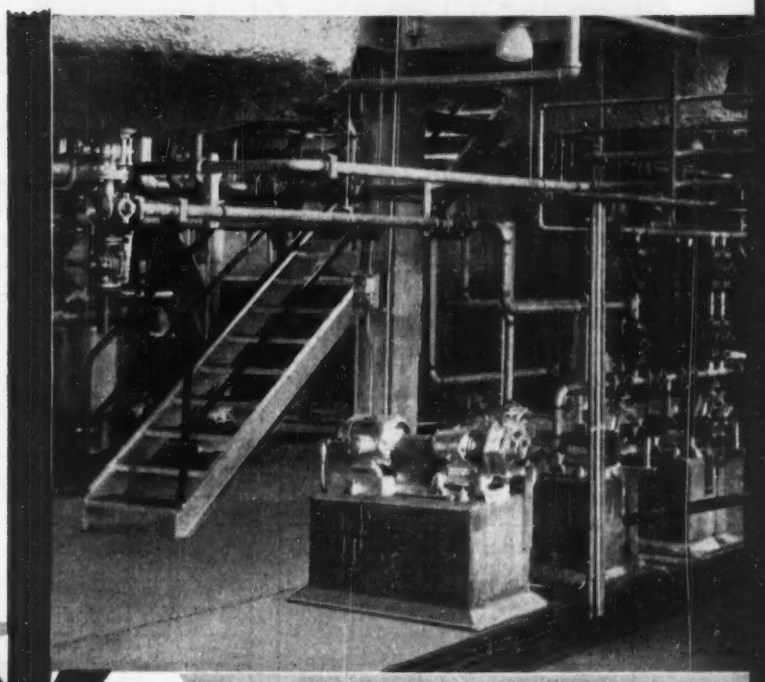
Kodak

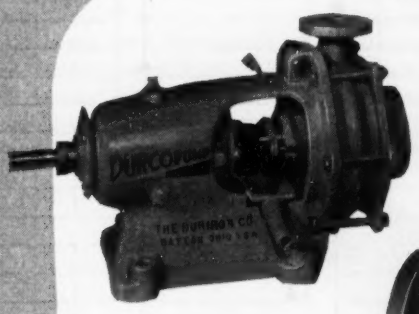
TRADE-MARK

In their new Elon facilities at Kodak Park, Eastman Kodak Co. uses Durco corrosion resisting pumps and valves to handle crude Elon, a developing agent, in the various stages of purification.

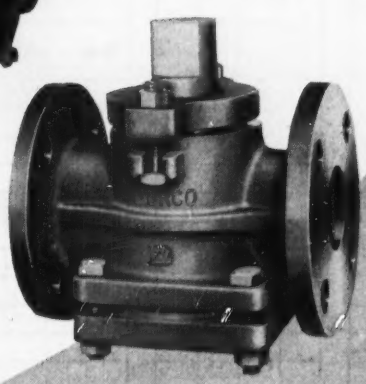
Series R Durcopumps and Durco Type F valves *(both shown)* can be depended upon for long, trouble-free service. These heavy duty chemical pumps are available in 12 standard Durco alloys to provide the best possible service in various corrosive conditions. The Durco Type F valve is an easily operated, non-lubricated, maintenance-free plug valve. Built of Durco corrosion resisting alloys, with a Teflon®* sleeve, it has proved outstanding in hundreds of applications.

**Registered trademark of E. I. du Pont de Nemours & Co. Inc., for its tetrafluoroethylene resin.*





SERIES R STANDARD DURCOPUMP



DURCO TYPE F VALVE

For complete details on these Durco products write for free Durcopump Bulletin P/1 and Durco Valve Bulletin V/4.

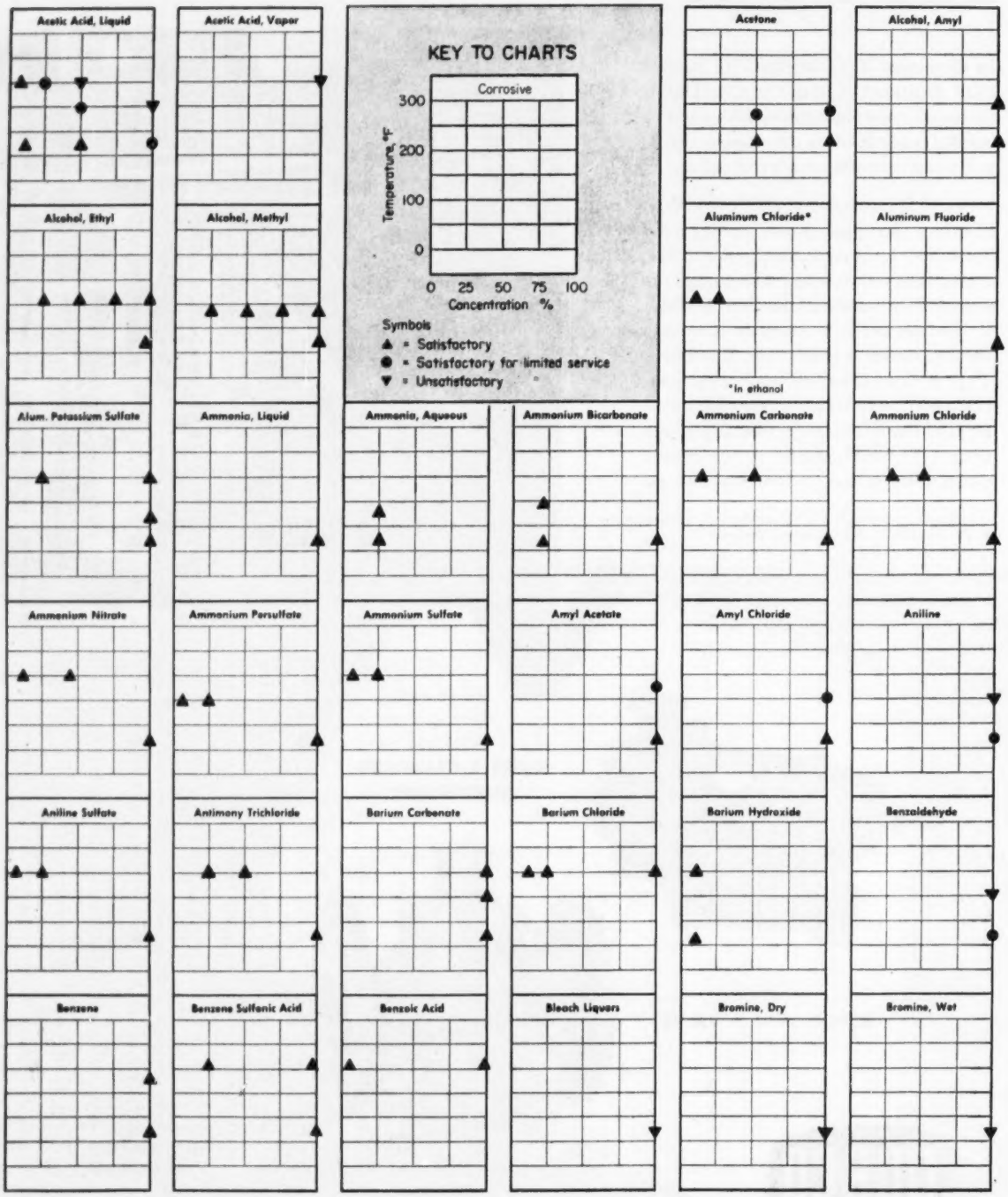
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, INC., DAYTON, OHIO

on extensive tests, they should be used for screening purposes only. Traces of foreign materials may change the resistance properties considerably. Whenever possible, the data should be checked under actual conditions of service. If this is not possible, the technical service department of a reputable supplier of epoxy resin cements should be consulted.

► REPRINTS—Available at 50¢ each. Send orders to CE Reprints, Room 2400, 330 West 42nd St., New York 36, N. Y.

Corrosion Resistance of Epoxy Cements and Coatings



(Continued on page 248)

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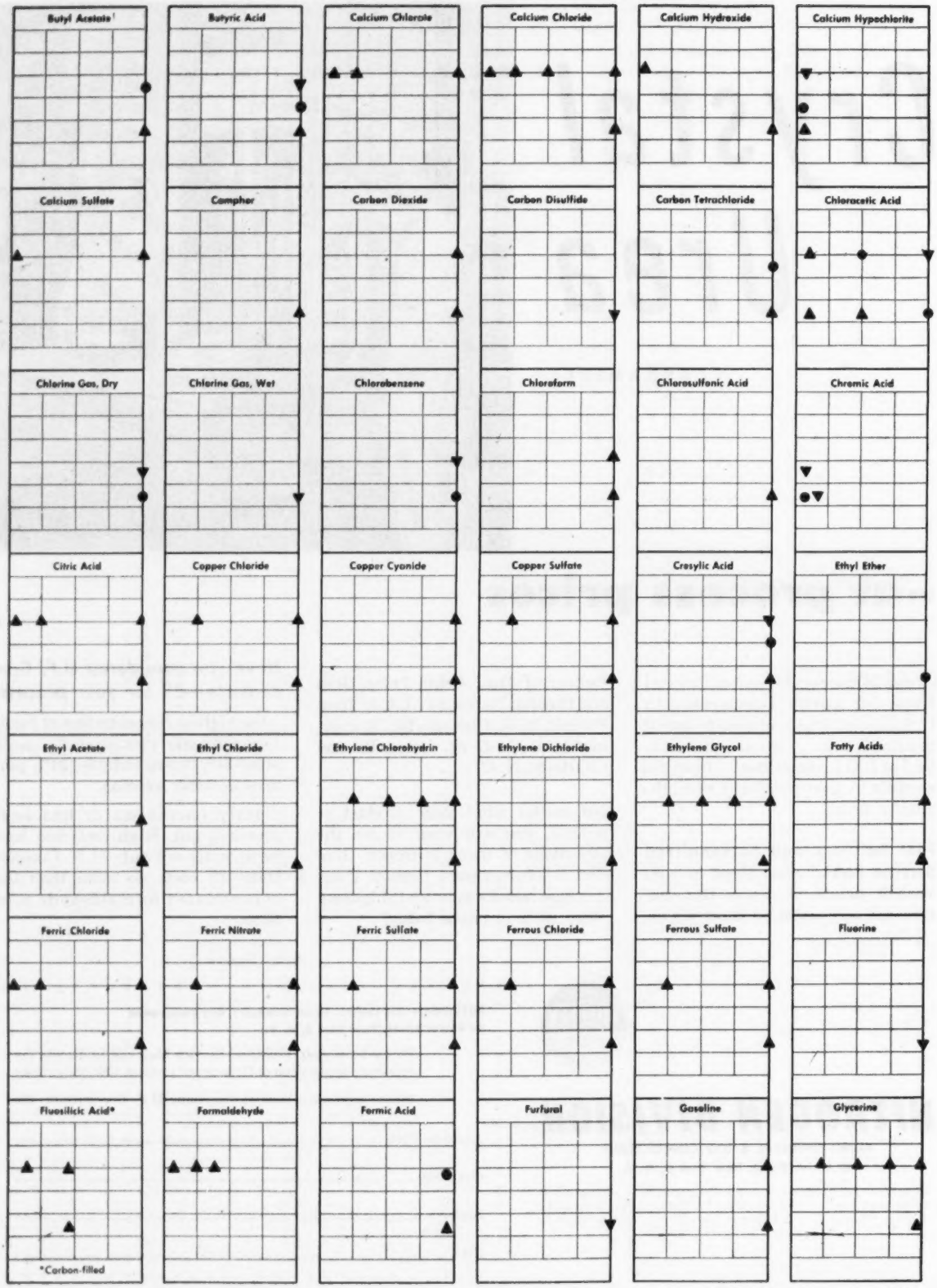
Corrosion Resistance of Epoxy Cements and Coatings, *cont.* . . .



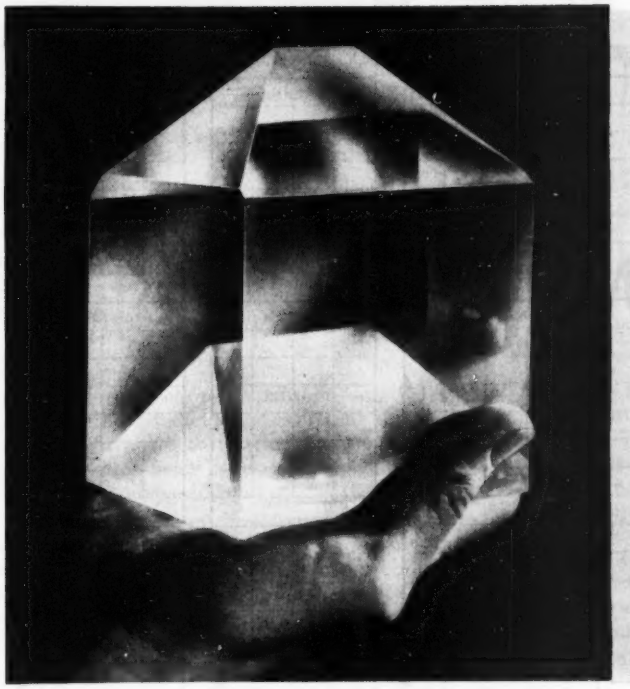
(Continued on page 250)

Pure enough to grow a perfect crystal

PROBLEM: The Brush Electronics Company, world's largest producers of synthetic piezo-electric crystals required phosphoric acid of exceptional purity for use as a component of the solution in which ADP* crystals were grown. Even minor impurities in the acid caused a distortion in the shape of the crystals. Leading producers of phosphoric acids were invited to submit samples.

SOLUTION: After thorough testing, it was found that only V-C 85% N. F. Grade Phosphoric Acid met the rigid requirements for purity. Brush Electronics uses V-C acid exclusively for growing ADP crystals.

*Ammonium dihydrogen phosphate.



ADP piezo-electric crystal, developed to meet the high power operating conditions of underwater sound use.

Perhaps V-C's high-purity 85% N. F. Grade Phosphoric Acid can help you overcome a production problem.

It will pay you to get in touch with V-C for a complete review of your phosphoric acid requirements. In addition to high-purity 85% N. F. Grade, V-C also manufactures 80% Food Grade, 75% Food Grade and 62½% Commercial Grade Phosphoric Acids. The services of technical experts are available to you without charge or obligation.

V-C Phosphoric Acids are shipped in glass carboys, stainless steel drums, latex-lined barrels, rubber-lined tank trucks and tank cars. Forty-eight hour tank truck delivery in Middle Atlantic and Southeastern states.

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Phosphoric Acids
Trisodium Phosphate
Disodium Phosphate-Anhydrous
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Phosphoric Anhydride
Tetraethyl Pyrophosphate
Alkyl Phosphites
Other Organophosphorus Compounds

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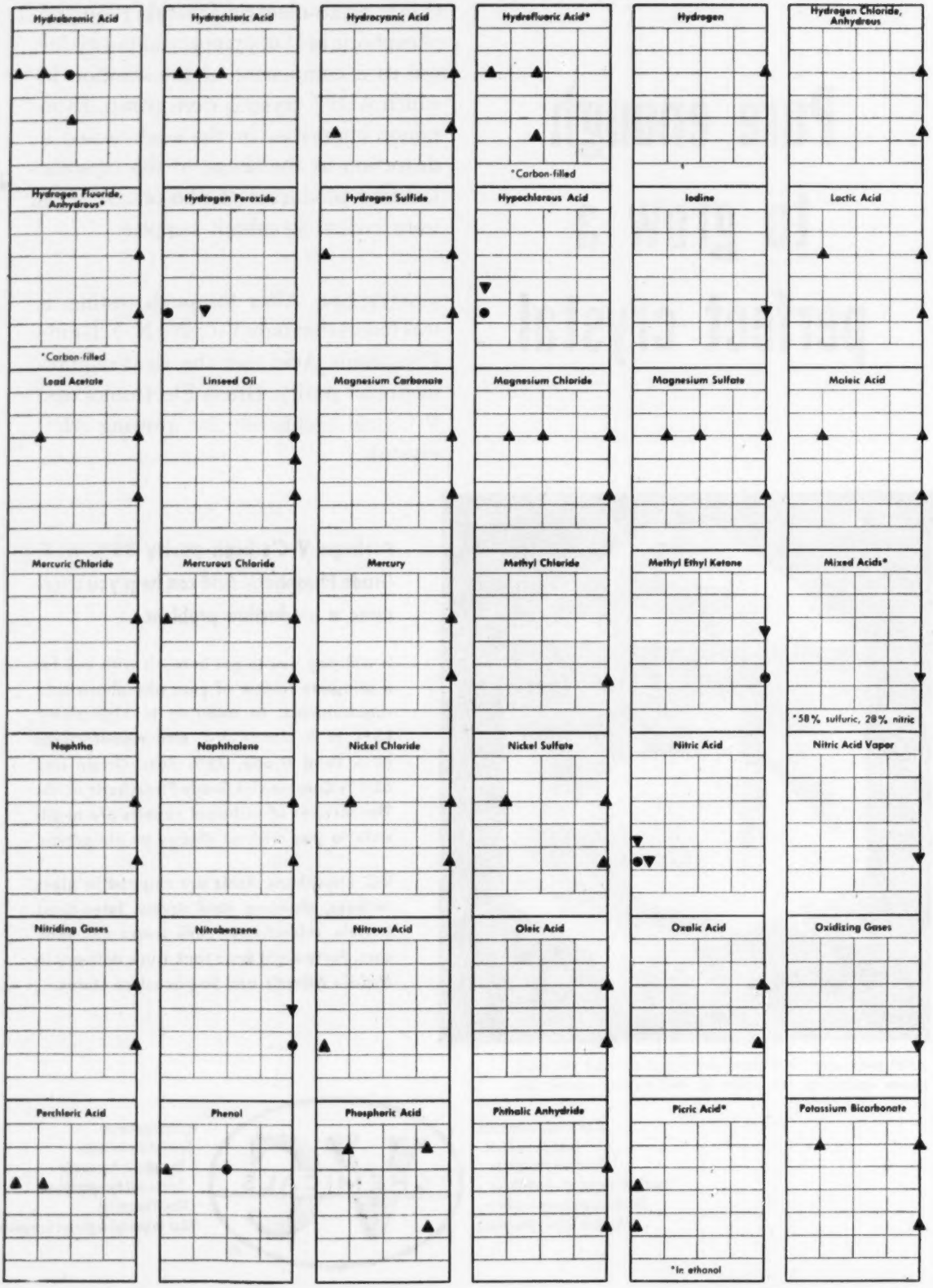
Corrosion Resistance of Epoxy Cements and Coatings, *cont.* . . .



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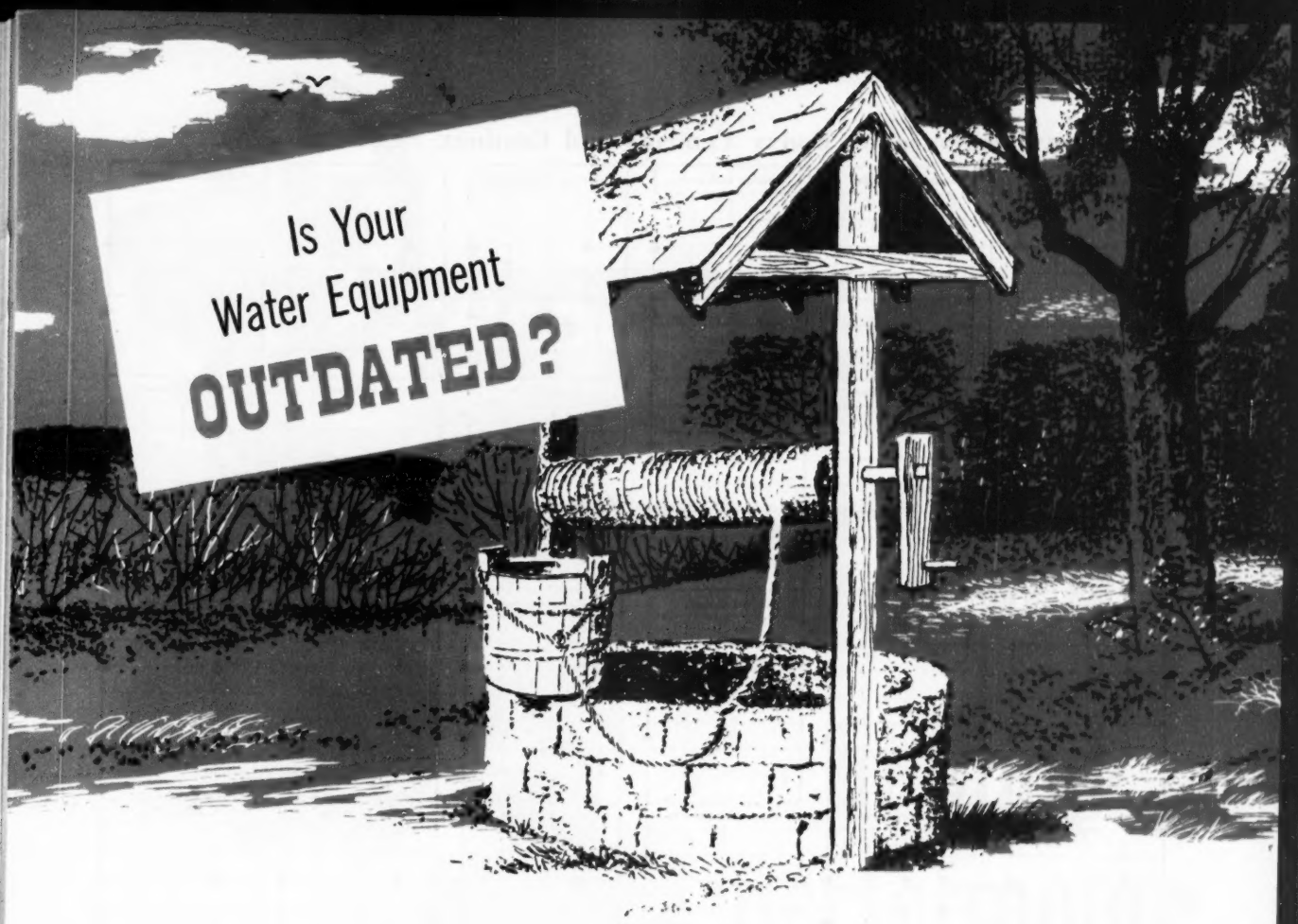

Think of Tomorrow's Water Needs Today

Growth—production—expansion—apply those words to city, farm or factory and you find that accomplishment is tightly tied to water. And yet planning for tomorrow's water needs is too frequently postponed until tomorrow becomes—today.

Layne ground water development service is unique in the dictionary sense of the word. A service that may—and frequently does—start with exploration. A service that has no ending—a continuing service—for Layne's responsibility to a Layne project or installation lasts as long as the need for water exists.

That service is available to everyone. It costs no more—and usually a lot less—because from initial surveys and test drilling to completed installation Layne brings to any job of any size the pooled knowledge of nearly three quarters of a century.

The Layne organization is glad to be of service on any immediate phase of ground water development—maintenance or modernization of existing equipment—new pump equipment—drilling—exploration or water treatment.

But also it is wisdom to use that service today in forecasting the needs of tomorrow. Why not permit Layne to make—with your assistance—the plans that will provide a dependable adequate water supply for the years that lie ahead.

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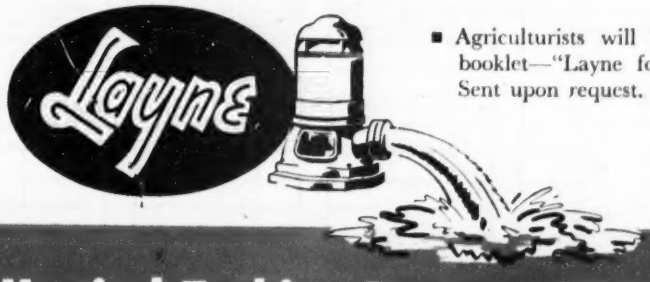
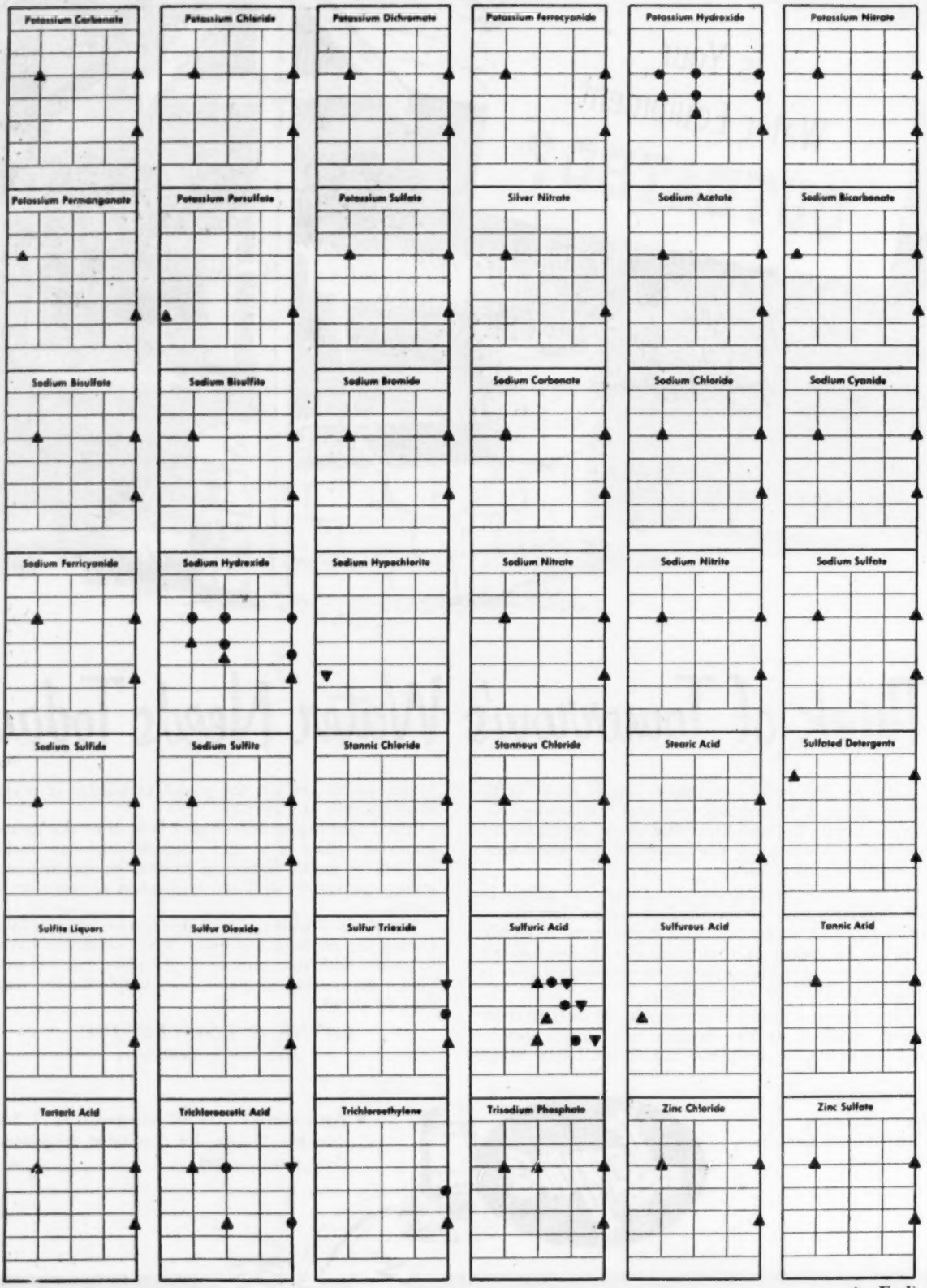


■ Agriculturists will be interested in a free booklet—"Layne for Profitable Irrigation." Sent upon request.

Water Wells • Vertical Turbine Pumps • Water Treatment

Corrosion Resistance of Epoxy Cements and Coatings, *cont.* . . .



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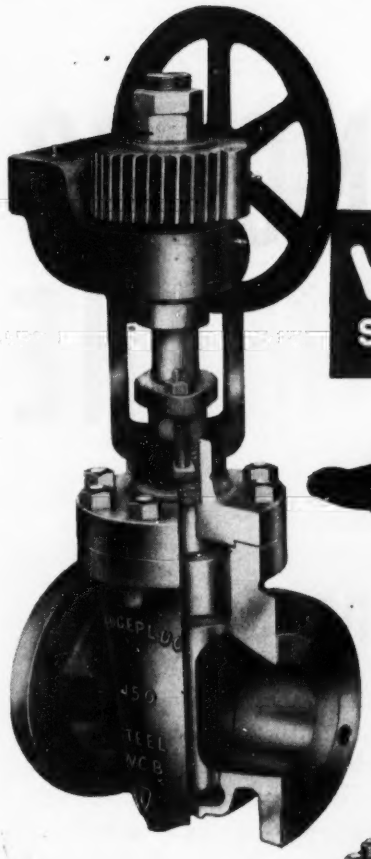
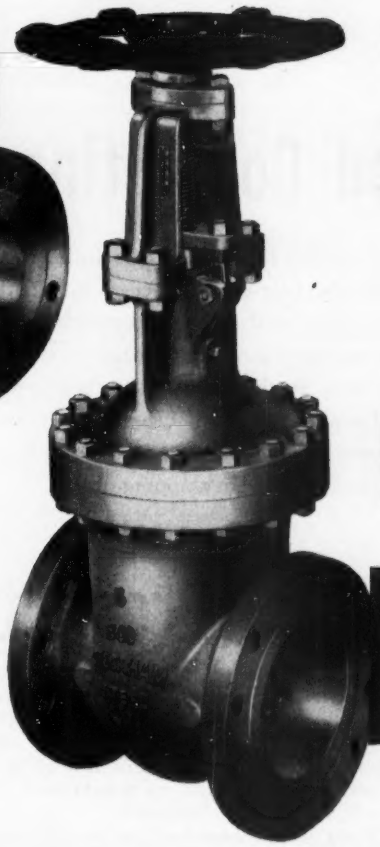


WEDGEPLUG
STEEL DRY PLUG VALVES



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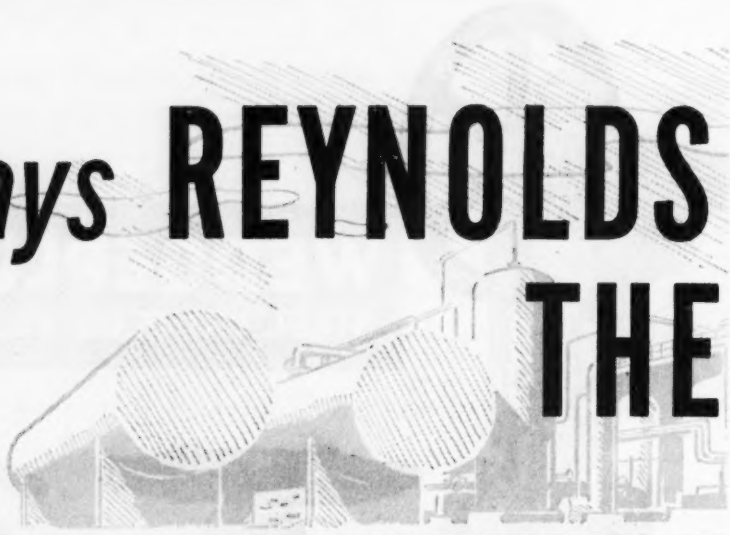

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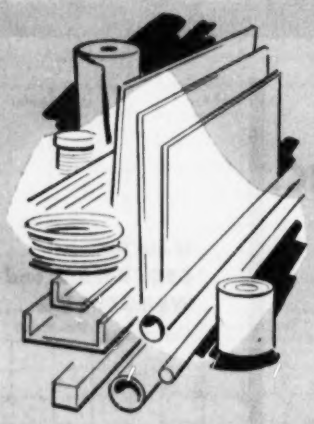
Rely on Reynolds for help in the solution of your problems involving chemicals, corrosion, processing, construction and shipping containers. The staff of each Reynolds regional office includes a chemical engineer as well as specialists in the other phases of engineering. When further consultation is necessary, a fully integrated technical staff at the main office in Louisville is ready to show you how to save time, money and labor with Reynolds chemicals, mill products and aluminum shipping drums.

3. Aluminum Mill Products



Tubing for Heat Exchangers, including condensers. Aluminum offers high heat transfer and corrosion resistance with low initial, shipping and handling costs.

Tubing for Instrument Lines. While less costly than other nonferrous tubing, lighter weight aluminum is comparable in mechanical characteristics and resistance to corrosion.

Pipe for Field and Process Applications. Aluminum pipe resists corrosion, has smooth inner surfaces and is non-sparking . . . plus being lightweight for handling and installation economies.

Flat and Coiled Sheet for Bulk Insulation Jacketing. Lasting appearance, easy application and added insulation are provided by aluminum.

Sheet and Plate. For process vessels, trays and bubble caps, storage tanks, and building applications aluminum has many advantages. Its non-sparking characteristic is important around highly volatile products.

Structurals, Rod and Bar are ideal for lightweight piping supports, framework, ladders and scaffolding.

Electrical Conductor for uses including transmission and distribution lines and bus conductors. Lightweight aluminum is easy to handle and has a distinct price advantage.

Powders and Pastes for heavy explosives, pyrotechnics, thermite reactions, aerated concrete and pigment for plastics and paints.

SERVES CHEMICAL INDUSTRY

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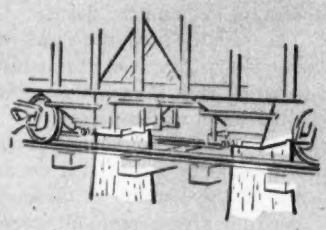

Organic Free Alumina Trihydrates. Premium quality chemicals, selling at a standard commercial price, are naturally snow-white and purer than any other similar products now available.

Reynolds Activated Alumina. An economical, regenerative desiccant for process equipment, packaging and drying of gases and liquids.

Calcined Aluminas. These low-cost, high-purity products improve qualities of refractories, abrasives, ceramics and glass.

4. Benson Aluminum Drums

Thanks to non-rusting aluminum, these superior quality shipping containers cut replacement costs . . . reduce handling and maintenance charges . . . slash shipping costs . . . and protect against the spoilage and contamination of chemicals.

Five basic types of drums are available, with modification for each requirement. One of them is especially designed to solve your shipping problem. Consult the Reynolds office nearest you for full information or write for a brochure to Reynolds Metals Co., 2567 S. Third St., Louisville 1, Ky.

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Each book is an authoritative reference on a single aspect of aluminum design or fabrication. They are yours on request. Write or call for a complete list of Reynolds technical literature and movies.

See "Mister Peepers" Sundays, NBC-TV. Consult local listings for time and station.

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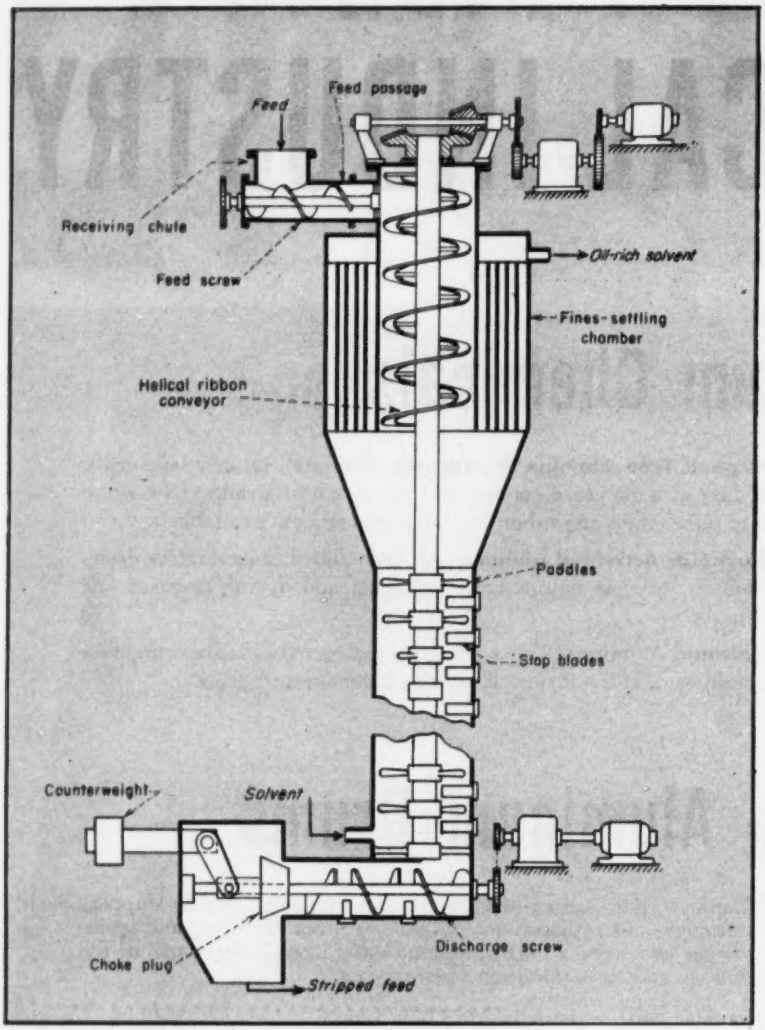
FROM THE PRODUCERS OF REYNOLDS ALUMINUM

NEW EQUIPMENT PATENTS



Improved Extractor Design

Use of paddles and stop blades prolongs solid-liquid contact. Edge over conventional counter-current extractors: higher yield in less time.

Intimate contact between oil-bearing solids and the solvent hikes the efficiency of a new countercurrent extractor. By controling the speed of the solids as they fall through the solvent, the new design prolongs solid-liquid contact. The gimmick: use of propeller-type paddles in the extraction tower.

▶ **Solids Flow**—In the new apparatus, solids feed into a receiving chute, move through a feed passage (by means of a feed screw) and enter a tube at the top of the column. Flaked material in the feed passage provides a seal to prevent the escape of solvent vapors from the tower.

A helical ribbon conveyor, fixed on a central shaft, moves the flakes down the column to the extraction section. When they begin to absorb solvent, they settle by gravity. The shaft rotates slowly—about 0.1 to 20 rpm.

▶ **Unique Design**—In the extraction section, the shaft is provided with propeller-type paddles. These have a slight pitch and are so oriented that they offer mild opposition to the downward force on the flakes.

The paddles keep the flakes from falling too fast. A series of stop-blades, alternating with the paddles, prevents circular travel of the flakes.

Solids, settling through the tower, are removed by means of a discharge screw at the bottom. A choke plug (biased to closed position) prevents liquid escape.

Solvent, introduced at the bottom of the tower, rises and leaves at the top. After moving through the extraction section, the solvent passes through a fines-settler where (because of the chamber's wide construction) its velocity is reduced. Here minute particles settle.

The new tower design has been found to give better yields—in less time—than equipment in current use.

Raymond T. Anderson, the inventor, has assigned his patent, U.S. 2,663,623, to V. D. Anderson Co.

New Plate Design For Pulse Columns

In liquid-liquid extraction pulse columns, very fine droplets are formed. This makes for good contact, but can make coalescing and separating the liquids difficult.

You can make the job easy by using a new column design.

In the new column, the tops and bottoms of the perforated plates are composed of two different materials.

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CORROSION
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Top material is wettable by the heavier liquid. Bottom is wettable by the lighter liquid.

If the heavy phase is organic and the light phase aqueous, the plate top can be plastic (fluorothene or polythene) and bottom can be stainless steel.

A reversal of plate materials (i.e. steel top and plastic bottom) would accompany a reversal of phase densities.

William A. Burns and Warren F. Johnson have assigned the patent, U.S. 2,662,001, to the U.S. Atomic Energy Commission.

New Ways to Clean Bubble-Plate Towers

Two new methods for cleaning bubble-plate towers have recently been described by Patrick F. Dougherty and Lloyd G. Magill in patents assigned to the Sun Oil Co. Both eliminate the inconvenience of manual dismantling, cleaning and reassembling—a consumer of time and manpower.

• U.S. 2,662,041 describes the removal of sulfur from absorption tower bubble trays.

• U.S. 2,662,042 outlines a procedure for scale removal in absorption or fractionating towers.

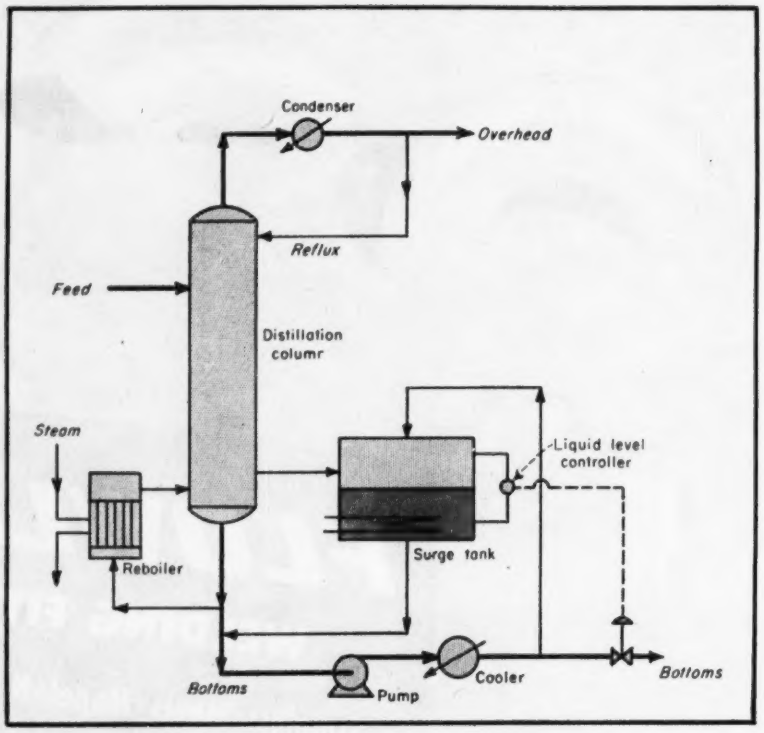
To remove sulfur, the bubble trays are filled with hot water. Steam, under pressure, is introduced at 260 to 300 deg. F. into the bottom of the tower. This temperature is high enough to melt the sulfur.

Agitation of the water-sulfur mixture on the trays is maintained by adjusting the steam rate so that the slot velocity through the bubble caps is between 1 to 5 ft. per sec. The mixture is removed at the tower bottom.

To remove scale, an aqueous pickling solution feeds continuously into the top of the tower while inert gas is introduced at the bottom. The solution contacts the same metal surfaces as does the liquid in normal operation. The gas provides agitation on the bubble trays.

Scale is taken off suspended in the pickling agent. It is removed by settling, straining or filtering. Clarified pickling solution is re-cycled, thus reducing the total amount of solution required.

Operating details are outlined in the patents.



How to Distill Heat-Sensitive Compounds

Here's a new development to overcome the problems encountered in distilling thermally sensitive compounds. The trick: a novel shift of distilling apparatus.

The required liquid inventory is still kept in the reboiler. Its temperature, however, is held a good deal lower than that in other parts of the still.

▶ **Past Difficulties**—In conventional continuous distillation, a sizeable portion of liquid is kept in the reboiler. This avoids fluctuations in column temperatures. Residence time of the mixture, at its boiling point, is often 3 to 7 hr. This prolonged heating can cause chemical changes in thermally unstable or polymerizable materials.

Vacuum distillation and the addition of stabilizing agents are two means of reducing or avoiding losses. These are not always successful and can even be harmful. Low pressures may reduce the efficiency of the still. Stabilizing agents may contaminate the product.

▶ **New Method**—These difficulties are overcome by connecting a surge tank to the column and reboiler. The tank inventory temperature is kept below the critical point (at which chemical changes occur).

As shown, part of the bottom stream runs to the boiler. This is preferably of the vertical-tube, natural-circulation type. The boiler has a maximum heat exchange surface with a minimum inventory volume.

Remaining bottoms are pumped through a cooler, to the surge tank, and eventually recirculated to the pump. A liquid-level controller regulates the flow of bottoms from the system. Since the pressures in the bottom of the column and in the tank are equalized, the liquid level in the column is the same as that in the tank. It is kept as low as possible without admitting vapor into the bottoms line.

The inventor, K. E. Coulter, also describes another modification of the apparatus arrangement.

Mr. Coulter has assigned his patent, U.S. 2,664,391, to Dow Chemical Co.

FACTS ON INFRARED FOR THE PROCESS PLANT

Make or Use Ethylene? We Have News for You...

Now you can check ethylene content continuously anywhere in your process stream. The result: maximum operating efficiency at all times.

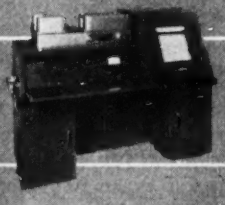
The TRI-NON* Infrared Analyzer will provide stream composition information with an accuracy and stability unmatched by other similar instruments. You can analyze feed streams for accounting purposes, measure ethylene content at any number of points in the purification process, determine total impurities in the purified gas and keep a check on residual ethylene in the outgas of ethylene reactors.

The table shows typical problems handled by the TRI-NON Analyzer. If your particular problem is not covered, why not define it to us. Our application engineers can specify performance in your plant.

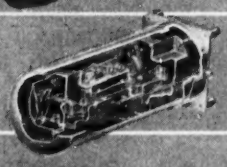
TRI-NON ANALYZER PERFORMANCE ON ETHYLENE ANALYSES

Process	Recorder Range, Full Scale	Other Stream Components	Equivalent Readability (1% of Scale)	Stability, 8 hours or longer (2% of scale)	Remarks
Ethylene Manufacture and Initial Purification	5% C_2H_4 or greater e.g. 0-5%, 55-60%, 20-80%, etc.	Any mixture of CH_4, C_2H_6, C_3H_8, C_3H_6 C_2H_2, CO, CO_2, N_2	.05% C_2H_4	0.1% C_2H_4	
	2% C_2H_4 or greater e.g. 0-2%, 24-26%	0-100% C_2H_6, C_2H_2, CO, CO_2, N_2, $C_3H_6 + C_3H_8$ <50%	.02% C_2H_4	.04% C_2H_4	C_2H_4 concentration below 50%
	99.5-100% C_2H_4, or wider range	CH_4, C_2H_6	.005% C_2H_4	.01% C_2H_4	Analyzer actually measures impurities
Final Purification	0-7500 ppm CH_4	<2% C_2H_6 + C_2H_2, remainder C_2H_4	75 ppm CH_4	150 ppm CH_4	
	0-5000 ppm C_2H_6	<2% CH_4 + C_2H_2, remainder C_2H_4	50 ppm C_2H_6	100 ppm C_2H_6	

THE ONLY COMPLETE RANGE OF INFRARED INSTRUMENTS TO MEET ALL REQUIREMENTS



FOR THE PILOT PLANT—*Model 14 Multi-Component Analyzer*— Continuously records the concentration of up to six components in a pilot process stream on a six-minute cycle. Ideal for tracking the effects of temperature, pressure, etc., changes in a pilot stream.



FOR THE PROCESS PLANT—*Model 93 BICHROMATOR* Analyzer —For continuous control of liquid or gas streams. Records the ratio of any two wavelengths chosen. Thermostatted; enclosed in explosion-proof containers.

FOR THE PROCESS PLANT—*Model 105 TRI-NON* Analyzer —Highly stable and sensitive. Suitable where there is considerable interference from stream components. Thermostatted; enclosed in explosion-proof containers.

*Trademark The Perkin-Elmer Corporation

Please send the bulletins checked:

Model 14 Models 93 and 105

NAME .....

TITLE .....

COMPANY .....

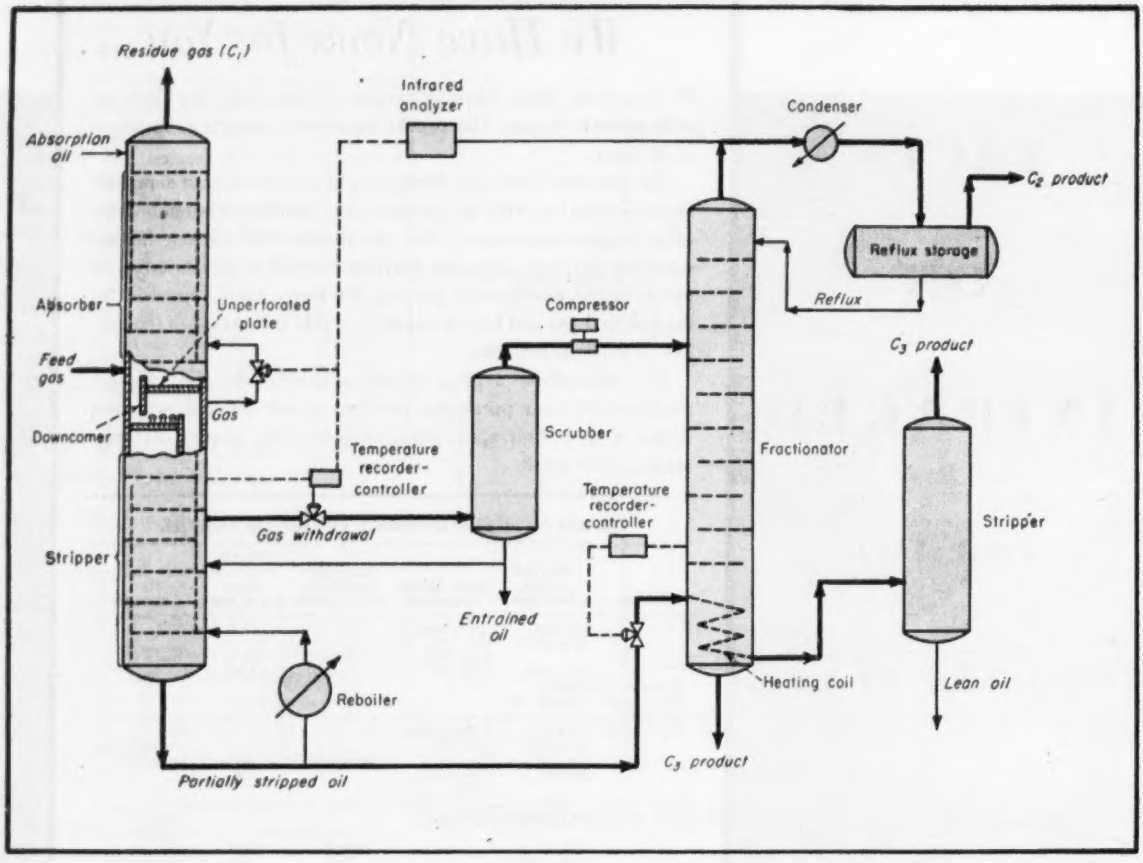
ADDRESS .....

.....

The Perkin-Elmer Corporation, 830 Main Avenue, Norwalk, Conn.
Regional Offices: New Orleans, Louisiana and Chicago, Illinois

WORLD'S LEADING MANUFACTURER OF ANALYTICAL INFRARED EQUIPMENT

PERKIN ELMER



Novel Separation of Gaseous Hydrocarbons

New combination unit separates C_1, C_2, C_3 gaseous hydrocarbons at conventional temperatures and pressures. Eliminates use of extreme conditions.

You know what a headache it is to separate C_1, C_2, C_3 gaseous hydrocarbons. You've got to use high-pressure, low-temperature equipment. Here's a combination absorber-stripper that will do the job at regular pressures and temperatures.

▶ **How It's Done**—A bubble-tower absorber is placed directly above the stripper, only an unperforated plate and downcomer separating the two units.

Gaseous feed enters the bottom of the absorber. Lean absorption oil takes up C_2 and C_3 hydrocarbons plus a small amount of C_1. Gases rise, countercurrent to the oil, and C_1 product is taken overhead.

Rich oil flows through the downcomer into the stripper. Heat from the reboiler vaporizes C_1 and C_2 and small amounts of C_3 from the oil. Vapors pass up the column, countercurrent to the rich liquid. Stripped material, containing C_3, leaves the bottom of the stripper.

▶ **Separating C_2 and C_3**—As vapors rise in the stripper, they remove C_1 and C_2 from the oil. Result: C_3-rich region appears in the stripping zone. Gas concentrated in this area is practically free of C_1, but contains some C_3.

A gaseous side-stream, taken off at this point, flows to a scrubber. Here entrained oil is removed. Some cooling occurs, resulting in partial condensation of the gas. Condensate is returned to the stripper.

Vapors pass to a compressor where the pressure is increased sufficiently to allow conventional fractionation of C_2 and C_3 hydrocarbons. The C_2 is taken off as overhead and C_3 as bottoms from the distillation column.

Rich absorption oil, passing through a heating coil in the bottom of the fractionator, supplies the heat required. Temperature on one of the bottom trays regulates the amount of hot oil passing through the coil.

Rich oil goes to a second stripper

The Difference is Experience

Whether you plan to build a house or a multi-million dollar chemical plant, you look for a contractor with a record of satisfactory experience. Experience comes from doing things repeatedly and profiting by early mistakes. It is not acquired in a day or a year but grows in value and importance as the years go by.

That's why, in the field of chemical plant construction, the name Chemico has become a synonym for experience...forty years in fact, with over 800 installations standing as a tribute to that experience.

When you buy a Chemico plant, whether it be for the manufacture of sulfuric, phosphoric or nitric acid, or for ammonia, methanol, urea or any other heavy chemical, you purchase also that intangible thing that assures satisfactory plant performance—EXPERIENCE.

CC-253

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

CABLES: CHEMICONST, NEW YORK

TECHNICAL REPRESENTATIVES: CYANAMID PRODUCTS LTD., LONDON • CHEMICAL CONSTRUCTION (INTER-AMERICAN) LTD., TORONTO • SOUTH AFRICAN CYANAMID (PTY) LTD., JOHANNESBURG

CHEMICO

Chemico plants are profitable investments

for recovery of C_3. Lean oil is then available for re-use as an absorbing medium.

▶ **Strict controls**—Product composition is governed by a series of control valves. Overhead from the first stripper passes to the bottom of the absorber through the first valve. This valve is regulated by the composition of overhead from the fractionator. Purity of C_2 product determines the size of the valve opening. Thus, if C_2 product contains excess methane, the valve opening will widen, allowing more C_1-rich gas to flow to the absorber.

A second control valve regulates the rate of removal of C_2-rich gas from the stripper. This valve is operated by a recording temperature controller which keeps the stripper temperature slightly above the withdrawal point at a set value.

As the C_1 valve opens (to admit more C_1-rich gas to the absorber) additional heat is carried to the temperature controller point. This opens the withdrawal valve further. Accordingly, the controller is reset to a higher temperature to allow increased feed of C_2-rich gas to the stripper.

Several detailed examples are cited for the separation of light hydrocarbons and other gaseous mixtures.

The patent, U.S. 2,661,812, has been assigned by the inventor, Forrest E. Gilmore, to Phillips Petroleum Co.

Solvent Selectivity Key To Paraffin Extraction

Want to remove small amounts of paraffins or naphthenes from aromatic hydrocarbons? To do it you'll need a solvent whose selectivity is the reverse of those normally used—one in which paraffins are more soluble than aromatics.

A recently revealed patent discloses that fluorocarbons will do the trick. Perfluorodimethylcyclohexane, perfluoromethyldecalin and perfluorokerosene are recommended.

The fluorocarbons can also be used in combination with another solvent. More than fifty secondary solvents, all satisfactory, are identified in the patent. Those preferred, however, are triethylene and diethylene glycol.

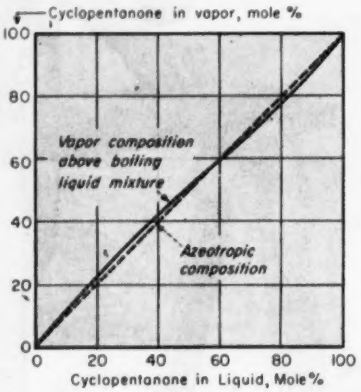
When a combination of solvents is used, a three-phase mixture results:

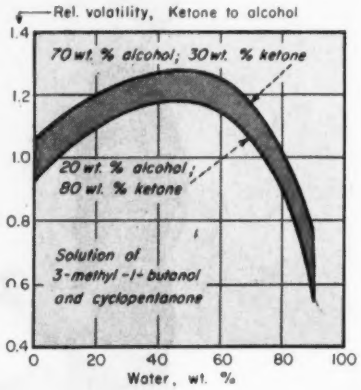
- Fluorocarbon layer, rich in non-aromatics.
- Glycol layer, rich in aromatics.
- Hydrocarbon layer, recycled.

Here's how tie-line data is affected by reverse selectivity:

Percentage of Benzene	
. . . in Triethylene Glycol layer	
Extract	Raffinate
94.5	56.2
92	42
87	17
70	9
. . . in Perfluoromethyldecalin layer	
Extract	Raffinate
88.2	94.7
56.5	60.0
55.3	59.2

U.S. 2,663,670 has been assigned by Alfred W. Francis and George C. Johnson to Socony-Vacuum Oil Co.





Separating Alcohol-Ketone Azeotropes

Economy and convenience are the aims of this new method to separate cyclopentanone from 2- and 3-methyl-1-butanol. The new process hinges on the use of water as solvent in an extractive distillation.

▶ **Problem**—Heretofore, a major problem in Fischer-Tropsch synthesis has been the efficient recovery of large quantities of alcohols and ketones. Why the difficulty? These compounds form azeotropes.

To point up the importance of the problem: a synthesis plant (having a daily capacity of 6,000 bbl.) produces better than 1,600 lb. 2- and 3-methyl-1-butanol and 1,400 lb. cyclopentanone per day. Until now there hasn't been an efficient way to separate these compounds.

▶ **Solution**—In the new method, the distillation is carried out in a conventional column having a washing and stripping zone. Water entering at the top of the column affects the relative volatility of cyclopentanone to 3-methyl-1-butanol. Continuous extraction yields high-purity products.

Temperature of the dilution water is kept equal to that of the liquid flowing from the feed point plate. The column feed, alcohol-ketone mixture, is preheated to the equilibrium temperature of the descending column liquids. Preheated feed may be liquid, liquid-vapor or vapor.

The quantity of water used is critical. It determines: (1) the purity of materials coming from either end of the column, (2) whether materials are recovered as tops or bottoms.

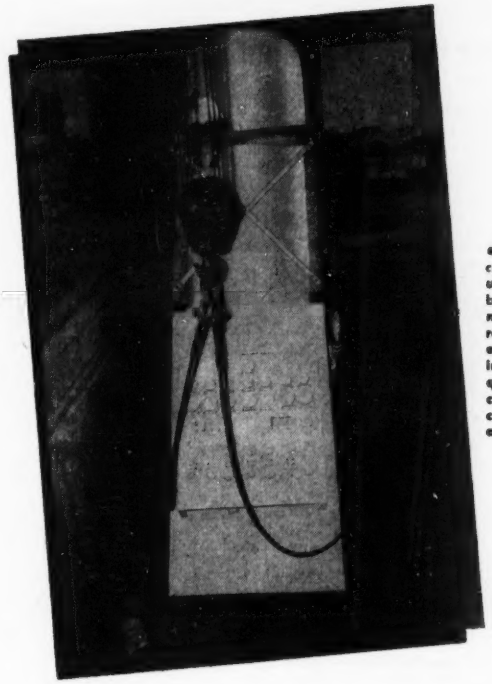
▶ **Illustrated**—The effect of water addition on the relative volatility of cyclopentanone to 3-methyl-1-butanol is illustrated graphically.

With water concentrations up to about 15 percent, don't expect any separation. From 15 to 40 wt. percent

This department is designed to keep you up-to-date on chemical equipment and processes. You can get any patents, including those mentioned here, by ordering from the Commissioner of Patents, Washington 25, D. C. Each patent costs 25 cents.

Compact "Package" Plants for

HYDROGEN PURIFICATION



• "Cold box"—major component of *Air Products* "Package" Plants—being readied for shipment. Unit contains separation and heat exchange equipment . . . controls, insulation, piping . . . requires only simple field connections to minor components (if required) and raw gas source.

Recover pure hydrogen from off-steams *at low cost* with an *Air Products* Low-Temperature "Package" Plant. Produce up to 10,000,000 cubic feet per day . . . at purities to 99.5%.

- **Plants are simple, compact, with pre-assembled components. They are inexpensive to install, operate and maintain.**
- ***Air Products* designs them to meet individual requirements . . . builds them using many standardized parts for low cost.**
- **You get *integrated* engineering-manufacturing service—with process guarantee—from specialists in low-temperature processing.**

To find out how to recover pure hydrogen by low-temperature separation, get in touch with *Air Products*. We can provide complete cost data . . . design and build "package" plants, or larger plants with greater capacities.

NEW 36-page BROCHURE explores the broad possibilities of low-temperature gas separation . . . illustrates *Air Products'* facilities. Write on company letterhead for a free copy.

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Specialists in Low-Temperature Processing

HYDROGEN SOURCES

Catalytic Reforming Processes

- Platforming
- Houdriforming
- Fluid Hydroforming
- Catforming
- Thermofor Catalytic Reforming

Thermal Cracking or Partial Oxidation of Hydrocarbons in Production of

- Ethylene
- Acetylene
- Ammonia
- Propylene
- Butylene

Process Used to Produce Thermal Carbon Black from Natural Gas

HYDROGEN USES

In the Oil Refinery

- Partial reduction of gum-forming gasoline constituents
- Hydrodesulfurization of naphthas, kerosenes, gas oils derived from high-sulfur crudes
- Hydrogenation-cracking of residues, lubricating oils

Petrochemical

- Ammonia synthesis gas
- Hardening of fats
- Production of glycols from aldols . . . alcohols from esters, glycerides . . . amines from nitriles

Other

- Reduction of sulfur and nitrogen content of non-petroleum hydrocarbons such as shale oil
- Production of sponge iron from iron ore dust

Air Products
INCORPORATED

LOW-TEMPERATURE SEPARATION PLANTS

water, relatively pure alcohol can be recovered. But at the top of the column, ketone is enriched and separation becomes difficult.

Between 40 and 55 wt. percent water, relatively good separation of both products can be obtained. From 55 to 70 wt. percent, again, as in the 15 to 40 wt. percent range, only pure alcohol is recovered.

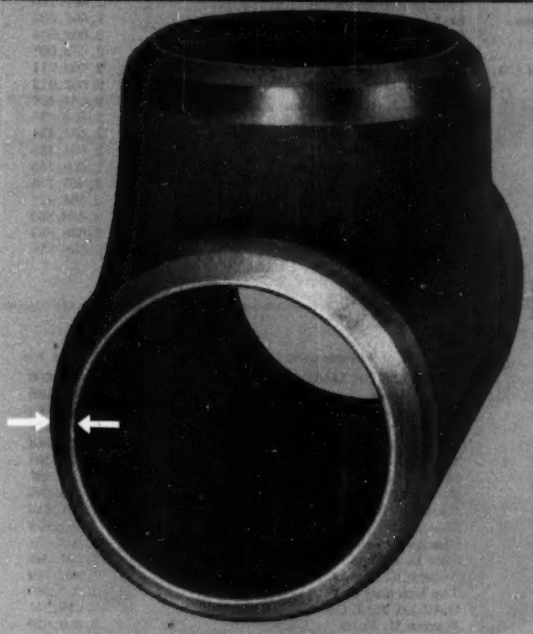
In the 70 to 80 wt. percent range, you can't get either product in pure form. Relative volatility reverses in this range. At concentration of 85 percent, you get pure products—ketone at the bottom and alcohol at the top of the column.

The inventors, Theodore Q. Eliot and Joe C. Weaver, Jr., have assigned their patent, U.S. 2,662,847, to Stanolind Oil & Gas Co.

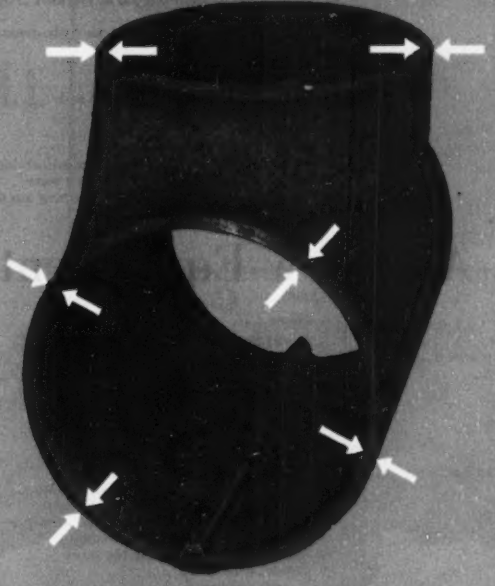
Your Checklist of New Process Patents

Product . . .	Process . . .	Inventor or assignee . . .	Patent No.
Catalysts	Regeneration of Fischer-Tropsch reduced iron catalyst	Phillips Petroleum Co	2,661,338
Dyes	Production of anthraquinone dyestuffs	Celanese Corp. of America	2,658,898
Fats and oils	Refining fatty oils	The M. W. Kellogg Co	2,658,907
	Fractionation of fatty materials	The M. W. Kellogg Co	2,660,590
	Treating tall oil	Armour & Co	2,662,849
	Oxidation of fatty acids	The C. P. Hall Co. of Ill	2,662,908
	Extraction of lower fatty acids	Hercules Powder Co	2,662,916
	Rice bran oil process	The De Laval Separator Co	2,663,717
	Continuous alkali refining of vegetable oils	The Sharples Corp	2,663,719
	Manufacture of polymerized fatty acids	Emery Industries, Inc	2,664,429
	Purification of fatty acids	Colgate-Palmolive-Peet Co	2,664,430
	Stabilizing refined soybean oil	The M. W. Kellogg Co	2,664,431
Fuels	Gaseous fuel production	Socony-Vacuum Oil Co., Inc	2,662,005–6
	Gasification of powdered caking-type coal	The M. W. Kellogg Co	2,662,007
	Oil gas process	The Gas Machinery Co	2,663,625
	Finely divided coke particles from carbonized coal	The Texas Co	2,664,390
Gases	Air separation	Joy Manufacturing Co	2,663,167
	Defrosting gas separation systems	Air Products, Inc	2,663,168
	Nitrogen from air by oxygen adsorption	Boeing Airplane Co	2,664,171
	Continuous production of chlorine dioxide	Edelbert E. Kestling	2,664,341
	Production of high purity HCl	Shell Development Co	2,664,342
	Acetylene from incomplete combustion of hydrocarbons	Badische Anilin-und-Soda-Fabrik A. G	2,664,450
Hydrocarbons	Catalytic conversion of hydrocarbons	Phillips Petroleum Co	2,662,003
	Catalytic conversion of hydrocarbons	The M. W. Kellogg Co	2,662,050
	Conversion of heavy hydrocarbons	Sinclair Refining Co	2,662,051
	Purification of cyclohexene	E. I. du Pont de Nemours & Co	2,662,102
	Shale oil refining	Shell Development Co	2,662,843
	Isomerization of xylenes	Standard Oil Co. (Ind.)	2,662,925
	Simultaneous redox reaction of pentamethylbenzene	Standard Oil Co. (Ind.)	2,662,926
	Alkylation—using evaporative cooling	Stratford Engineering Corp	2,664,452
Inorganic chemicals	Production of magnesium hydroxide	Helmuth K. Keitel	2,659,661
	Selective flocculation of colloidal phosphate ore in the presence of clay	Tennessee Valley Authority	2,660,303
	Sodium hydroxide and hydrogen from elemental sodium	Ethyl Corp	2,660,517
	Purification of water by ion exchange	Ionics, Inc	2,660,558
	Hydrogen peroxide production	Food Machinery & Chemicals Corp	2,661,268
	Concentration of phosphate ores	Attapulgus Minerals & Chemicals Corp	2,661,842
	Manufacture of sodium hydrosulfide solution	The Pure Oil Co	2,662,000
	Preparation of ammonium sulfate	Alfred M. Thomsen	2,662,811
	Alumina from aluminum chloride hexahydrate	Universal Oil Products Co	2,663,620
Metals and ores	Electrodeposition of nickel	The Harshaw Chemical Co	2,662,853
	Production of metal powders	Badische Anilin-und-Soda-Fabrik A. G	2,663,630
	Controlled reduction of metallic oxides	The International Nickel Co	2,663,631
	Production of titanium metal	National Lead Co	2,663,634
	Differential froth flotation of lead-zinc ores	Pierre R. Hines	2,664,198
	Flotation recovery of molybdenite	Phelps Dodge Corp	2,664,199
Organic chemicals	Preparation of mixed aromatic-aliphatic ethers	Pennsylvania Salt Mfg. Co	2,659,753
	Preparation of 6-chloro-o-cresol	The Dow Chemical Co	2,659,759
	Bromination of benzene hydrocarbons	The Dow Chemical Co	2,659,760
	Separation of aromatic amines	American Cyanamid Co	2,660,581
	Neutralization of sulfonated organic esters	Colgate-Palmolive-Peet Co	2,660,588
	Catalytic alkylbenzene synthesis	Allied Chemical & Dye Corp	2,660,610
	Manufacture of tetraethyl lead	Ethyl Corp	2,661,361
	Preparation of organic phosphorus cpds	E. I. du Pont de Nemours & Co	2,661,364
	Oxidative dehydrogenation of cyclic hydrocarbons	Socony-Vacuum Oil Co., Inc	2,661,380
	Menthol from fractionated mint oils	Iowa State College Research Foundation, Inc	2,662,052
	Alcohol from grain	Leo M. Christensen	2,662,842
	Purification of acetone by extractive distillation	Standard Oil Development Co	2,662,848
	Extraction of valuable products from bark	Oregon State Board of Forestry	2,662,893
	Purification of phthalic anhydride	Allied Chemical & Dye Corp	2,662,901
	Polychlorinated phenol derivatives	The B. F. Goodrich Co	2,662,918
	Hydrolysis of alkenyl-alkyl ethers in the vapor phase	Eastman Kodak Co	2,662,919
	Phenols from oxidised aromatics	Dresser Operations, Inc	2,662,923
	Preparation of CS_2	Standard Oil Development Co	2,663,622
	Alcohols from olefins by extractive distillation	Standard Oil Development Co	2,663,679
	Extractive distillation of allyl alcohol from n-propyl alcohol	Celanese Corp. of America	2,663,680
	Lower acid anhydrides recovered by distillation	Eastman Kodak Co	2,663,681
	Azeotropic distillation of alcohols	Ruhrchemie A. G	2,663,682
	Purification of straight-chain monohydric alcohols	Standard Oil Co. (Ind.)	2,663,703
	Noncatalytic condensation of aromatic cpds. with unsaturated organic cpds	Universal Oil Products Co	2,663,724
	Phenol and ketones from decomposed hydroperoxides	Hercules Powder Co	2,663,735
	Oxidation of aromatic hydrocarbons	Hercules Powder Co	2,663,740
	Production of methylal	The Dow Chemical Co	2,663,742
	Phenol from oxidized isopropyl benzene	Hercules Powder Co	2,663,743
	Catalytic hydration of olefins	Socony-Vacuum Oil Co., Inc	2,663,744
	Separation of isophthalic and terephthalic acids	California Research Corp	2,664,440
	Oxidation of aromatic cpds	Hercules Powder Co	2,664,447–8

EVIDENCE OF SUPERIORITY IN *Corrosive Service*



BEFORE *Midwest 4" extra heavy weight, carbon steel tee showing original wall thickness of tee at right before it was accidentally subjected to corrosive conditions.*



AFTER *When straight pipe in line had failed from corrosion, this Midwest tee was removed. Note amount and uniformity of wall thickness remaining.*

A valve leaked or somebody opened it by mistake . . . so the Midwest Tee shown above was subjected to dilute hydrofluoric acid in addition to its normal service in a 300° F. hydrocarbon line on an alkylation unit.

The highly corrosive acid caused failure of the straight pipe . . . so the entire line had to be replaced. When cut out of the line, the Midwest Tee was found to have a considerable (and uniform) wall thickness. There was no selective corrosion and the weld held up even better than the parent metal.

This was not special alloy made to resist corrosion, but regular Grade "A" carbon steel . . . the same as the new tee shown left above. We do not, of course, recommend carbon steel for corrosive conditions, but, in emergency, it gives good account of itself.

The exclusive Midwest manufacturing process produces fittings of superior metallurgical properties. The metal is worked in compression . . . it is not stretched or extruded, and distribution is uniform. After forming and welding, the fitting is stress-relieved. For further information, write us for a copy of Catalog 54.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—30 Church St. • Chicago 3—79 West Monroe St.
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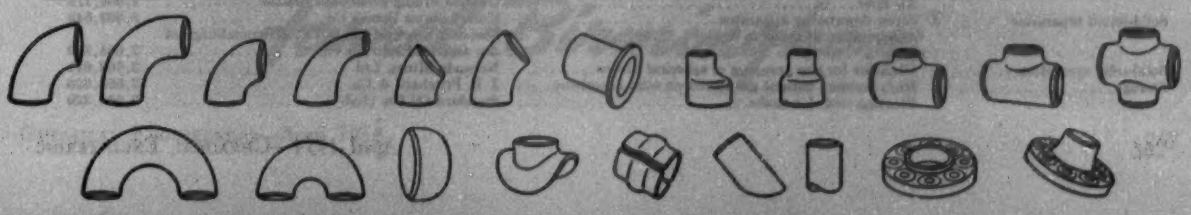
MIDWEST WELDING FITTINGS

IMPROVE DESIGN AND REDUCE COSTS



PROCESS PATENTS . . .

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No.
Pharmaceuticals	Purification of antibiotics	Mathieson Chemical Corp	2,664,419–20
Rubber	Preparation of plastic condensable synthetic rubbers	The B. F. Goodrich Co	2,662,874
	Antioxidant treatment to preserve rubber	Monsanto Chemical Co	2,664,407
Synthesis gas and products	Removal of oxygenated organic cpds. from hydrocarbon mixtures	Standard Oil Co. (Ind.)	2,660,600
	Manufacture of synthesis gas	Phillips Petroleum Co	2,661,270
	Removal of oxygenated organics from hydrocarbons	Standard Oil Development Co	2,661,362
	Preparation of synthesis gas at elevated pressures	The Texas Co	2,662,004
	Hydrocarbon synthesis	Standard Oil Development Co	2,662,090
	Temperature control in catalytic hydrogenation of CO	Metallgesellschaft A. G	2,662,911
	Hydrocarbon synthesis reaction	Standard Oil Development Co	2,662,912
	Production of synthesis gas	Phillips Petroleum Co	2,664,402
	Synthesis of organic cpds	Phillips Petroleum Co	2,664,433
	Recovery of oxygenated organic cpds	Phillips Petroleum Co	2,664,434
	Separation of organic cpds	The M. W. Kellogg Co	2,664,435
Synthetic fibers	Preparation of linear polyamides	E. I. du Pont de Nemours & Co	2,659,713
	Production of improved viscose	American Viscose Corp	2,663,704
	Copolymers of acrylonitrile and nicotinamides	The Chemstrand Corp	2,664,412
Waxes	Manufacture of low-melting plastic waxes	Standard Oil Development Co	2,658,852
	Solvent fractionation of wax-containing mixtures	The Atlantic Refining Co	2,658,853
	Refining and stabilizing waxes	Standard Oil Development Co	2,658,856

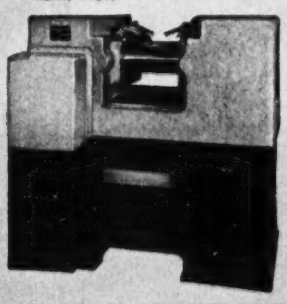
. . . And New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No.
Adsorption	Adsorption unit	Gesellschaft fur Linde's Eismachinen A. G	2,661,808
Chemical reaction	Two-stage photochemical reactor	Ethyl Corp	2,662,186
	Fluidized bed reactor	Hydrocarbon Research, Inc	2,664,346
	Catalyst chamber collector	Phillips Petroleum Co	2,664,347
	High pressure and temperature reactor	Phillips Petroleum Co	2,664,348
Conveying	Helical vibratory conveyor	Syntron Co	2,658,286
	Conveyor belt	Stavineer Corp	2,658,607
	Reciprocating grate conveyor	Barry-Wehmiller Machinery Co	2,658,608
Crushing and grinding	Means for lubricating tube mills	Joseph E. Kennedy	2,661,813
	Air swept tube mill with pocketed liner	Jean A. Slegten	2,661,908
	Rotary impact hammer for pulverisers	Charles E. Sennholtz	2,663,505
	Ball mill with feed and discharge at each end	John B. Martin	2,664,248
Distillation	Multicellular fractionating column	Aubrey K. Brewer	2,662,759
	Supporting beams for bubble trays	The Lummus Co	2,664,280
Drying	Dryer for ceramics	Gottfried M. J. Cremer	2,658,285
	Centrifugal dryer	Warren H. Noble	2,658,619
	Control mechanism for sheet dryer	Mason-Neilan Regulator Co	2,659,987
	Multiple batch dryer	Arthur E. Tanasse	2,661,544
Extraction	Solvent extractor	The French Oil Mill Machinery Co	2,663,624
Extrusion and molding	Injection molder	Hydraulic Molds Corp	2,658,237
	Extrusion of thermoplastics	Celanese Corp. of America	2,661,497
	Molding apparatus	United States Rubber Co	2,661,498
	Blending and warming extruder for plastics	Farrel-Birmingham Co., Inc	2,662,243
	Extrusion of thermoplastics	Extruded Plastics, Inc	2,663,904
Filtration	Apparatus for proportional feeding of a filter aid to liquid	The Paterson Engineering Co., Ltd	2,661,244
	Filter plate screen clip	American Cyanamid Co	2,663,431
	Inclined rotary vacuum filter	Aktiebolaget Kamyr	2,663,432
Fluid and particle flow	Pumping liquefied gases containing nitrogen	Air Products, Inc	2,661,608 & 2,663,166
	Elevator for granular material	Houdry Process Corp	2,662,796
	Circular chute for controlled flow of solids in a tower	Phillips Petroleum Co	2,664,190
	Line and valve system for handling fluidized particles	Gulf Oil Corp	2,664,338
Heat transfer	Muffle furnace	Harold N. Ipsen	2,658,744
	Plate heat exchanger	Meyer Frenkel	2,659,392
	Plate heat exchanger	Aktiebolaget Separator	2,659,580
	Heat exchange in the separation of air	Air Products, Inc	2,660,038
	Heat exchanger for continuous treatment of fluent material	John E. Laschinger	2,660,408
	Radiant fluid heater	Chemical Construction Co	2,660,519
	Vertical condenser with subcooler and vent	Stone & Webster Engineering Corp	2,661,190
	Plate-type heat exchanger	Houdaille-Hershey Corp	2,661,191
	Grids for cooling towers	C. D. Patents, Ltd	2,661,197
	Radiant heat exchanger	Industrikemiska Aktiebolaget	2,661,200
	Liquid-to-liquid heat exchanger	Niagara Blower Co	2,661,934
	Annular flow heat exchanger	Hydrocarbon Research, Inc	2,662,749
	Condensing system for distillation column	The Lummus Co	2,662,850
	Heat exchanger for cooling air at low temperatures	American Locomotive Co	2,663,170
	Apparatus using sonic waves in heat exchange	The Lummus Co	2,664,274
Instrumentation and control	Proportioning apparatus	Proportioneers, Inc	2,658,644
	Apparatus to measure catalyst activity	John M. Formwalt	2,658,819
	Device to measure gas densities	Republic Flow Meters Co	2,662,394
	Liquid density measurement	Precision Thermometer & Instrument Co	2,664,011
Liquid-liquid separation	Dialyzer	John F. Marchand	2,664,395
Mixing	Jet for mixing solids and a liquid	Thomas L. Katovisch	2,661,194
	Dissolving apparatus	Wallace & Tiernan Co., Inc	2,663,553
Solid-gas separation	Electrostatic precipitator	Westinghouse Electric Corp	2,661,809
	Continuous filtration of solids from gases	Karl Kauts	2,661,811
	Electrostatic precipitator	Westinghouse Electric Corp	2,662,608
	Centrifugal separation of suspended particles	Oswald X. Heinrich	2,662,610
	Liquid contact apparatus for cleaning gas	Herbert Simpson Corp	2,662,756
	Rotary electrostatic filter	Air-Maze Corp	2,663,380
	Elimination of dust particles (1 micron or less) from air	Aerosol Corp. of America	2,663,382
	Air filter	Owens-Corning Fiberglas Corp	2,664,172
Solid-liquid separation	Screw dewatering apparatus	United States Potash Co	2,662,642
	Precipitation of solids in liquids	Societe d'Electro-Chimie d'Electrometallurgie et des Acieries Electriques	2,664,349
Solid-solid separation	Classifier for size grouping of spherical bodies	Noranda Mines, Ltd	2,662,641
Storage	High-pressure natural gas stored on solid adsorbent	J. F. Pritchard & Co	2,663,626
	Floating roofs for tanks	Standard Oil Co. (Ind.)	2,664,220

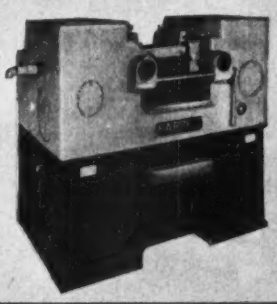
One of these FOUR DESIGNS may be just THE LABORATORY MILL you need

1 — FRONT VIEW

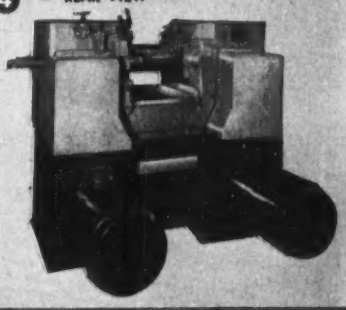
2 — REAR VIEW



3 — FRONT VIEW



4 — REAR VIEW



	Method of Speed Control	No. of Motors	HP Each Motor	Friction Ratio	Roll Speed (RPM) Front	Back
1	Constant	1(AC)	7½	1.4:1	23.5	33
2	Vari-pitch Pulley	1(AC)	7½	1.4:1	13 to 24	18 to 34
3	Vari-pitch Pulleys	2(AC)	5	Variable	20 to 38	18 to 34
4	Variable Voltage	2(DC)	5	Variable	4.5 to 34	6 to 45

Here is a standard, two-roll, 6" x 13" laboratory mill, which you can have with four different drive arrangements. One of these should give you exactly the roll speed, or speeds, and friction ratio you need for your experimental work.

Drive may be (1) by single AC motor with mill gearing to give constant roll speed and 1.4:1 friction; (2) by single AC motor driving the rolls through vari-speed sheaves to give a back roll speed range of 18 to 34 RPM and 1.4:1 friction; (3) by two AC motors with vari-speed drives for friction ratios from even speed up to 2.1:1; (4) by two DC motors with variable voltage control for ratios from even speed up to 10:1 friction.

Standard mills have self-contained automatic cascade lubrication, swinging scraper, tilting guides and knee-operated safety trip. Optional features include chrome-plated rolls, extra hand scraper, air-operated scraper, ratchet roll adjustment, and batch-off roll.

Send for further information about this versatile mill. Or, if you prefer, a Farrel-Birmingham engineer will be glad to discuss your laboratory equipment problems with you at any time.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston
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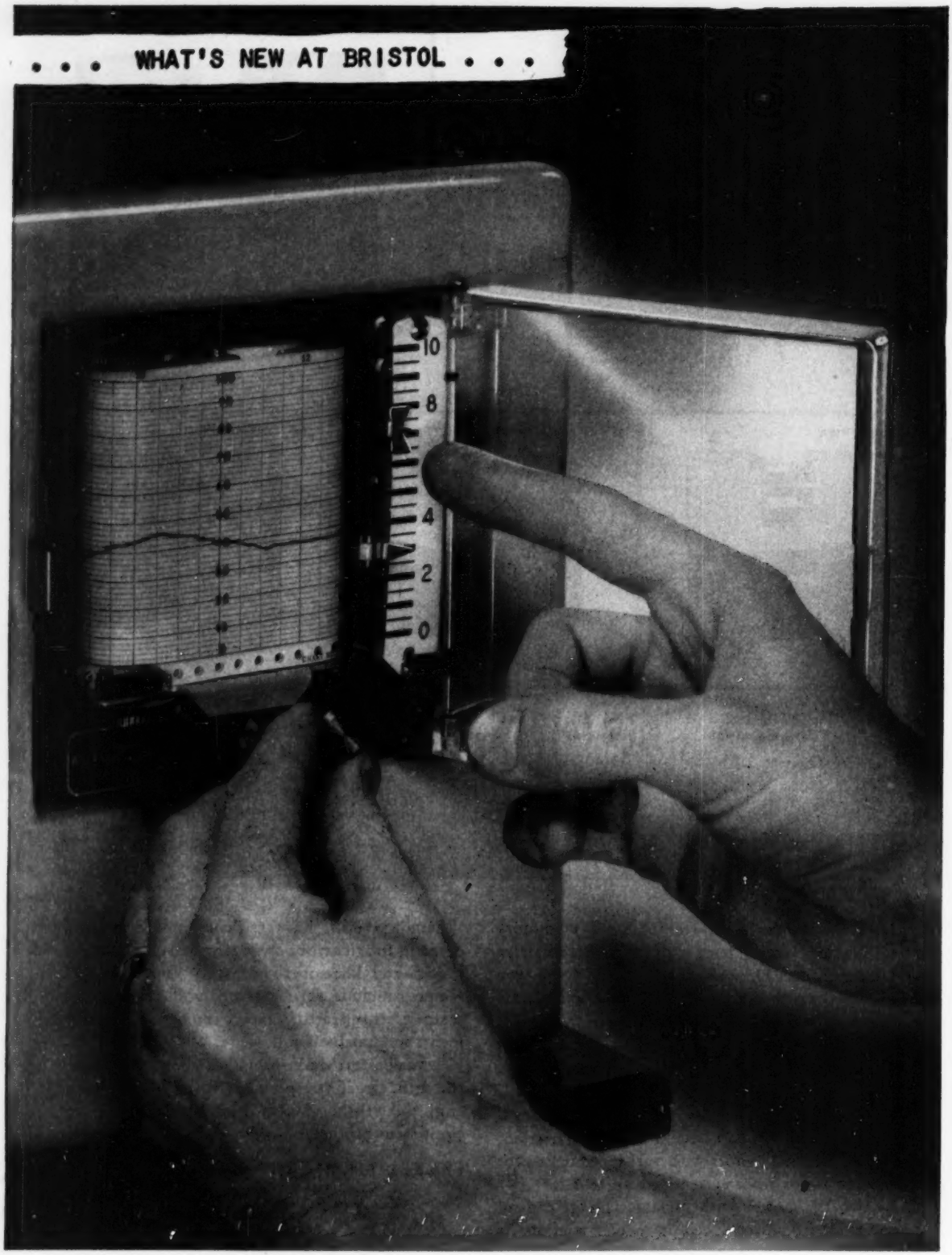
Farrel-Birmingham®



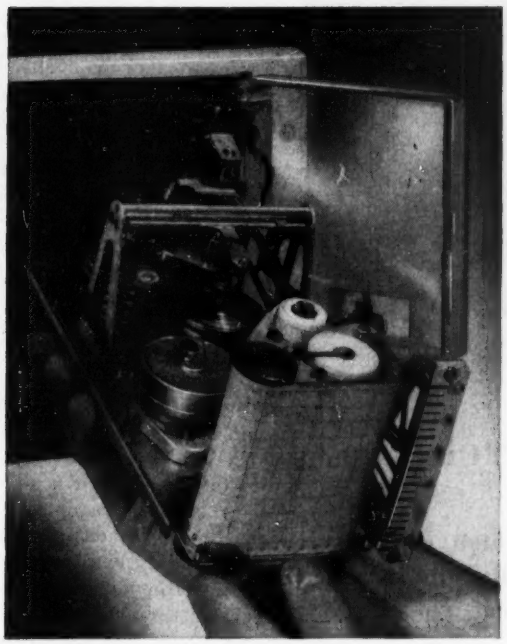
BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-to-read scale, high-visibility fluorescent pointers and shadow-proof door has earned a reputation as the "biggest miniature in the industry". There's no switching necessary to get a reading of the control valve position. The continuous valve-position indication, separate from set-point indication, gives continuous data on control valve position and process level. The high-precision, two-stage, no-drift set-point regulator has high-capacity (3 scfm) output for fast manual control in emergencies.

Instrument men call Bristol's METAGRAPHIC Recorder

"... the biggest little instrument in the industry"

Sounds contradictory, but it's true. Take a look at one of our new METAGRAPHICS mounted on a panel board alongside of other instruments. The Bristol unit stands out — seems bigger than the rest — although chances are it's actually smaller (5″x5½″). The answer is that the Bristol instruments have been *"human-engineered"*, making them easy to read, and clearly visible at greater distances.

To meet the increasing need for miniature instruments, we didn't simply scale down one of our larger recorders, we designed a completely new unit, creating a smaller instrument with all the advantages of the large one. In other words, the new METAGRAPHIC is a "big" little recorder.



TRUE PLUG-IN SERVICE is a big advantage to the operating man. If trouble is suspected in an instrument, the doubtful unit can be removed and a spare plugged in in a matter of seconds, with no interruption in the process operation, no loss of air, no loss of control.

"Human-engineered" METAGRAPHIC records pressure, temperature, vacuum, flow, differential pressure, and liquid level

Here are some of the advantages of the air-operated Metagraphic Recorders:

SIMPLICITY . . . fewer moving parts, fewer adjustments, and less service required. Range changes can be made in seconds.

CONTINUOUS VALVE-POSITION INDICATION . . . on same instrument scale as set-point scale, gives continuous data on control valve position — makes "bumpless" transfer possible simply by matching pointer positions — no need to read actual scale values — minimizes reading errors — speeds operations.

TRUE PLUG-IN SERVICE . . . provides great savings in installation costs. Cases can be ordered and installed before selecting range and type of control. Instruments can be plugged in later or interchanged at will. This adds up to a big advantage to the process design engineer — he doesn't need to make decisions during the design stage that can't be easily changed later.

CONTINUOUS OPERATION . . . complete unit can be retracted for inking pen, and for set-point and zero adjustment without disturbing record or control.

Get the whole story on the "human-engineered" METAGRAPHICS — how they can help you get more accurate measurements, faster and easier. Write us today. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

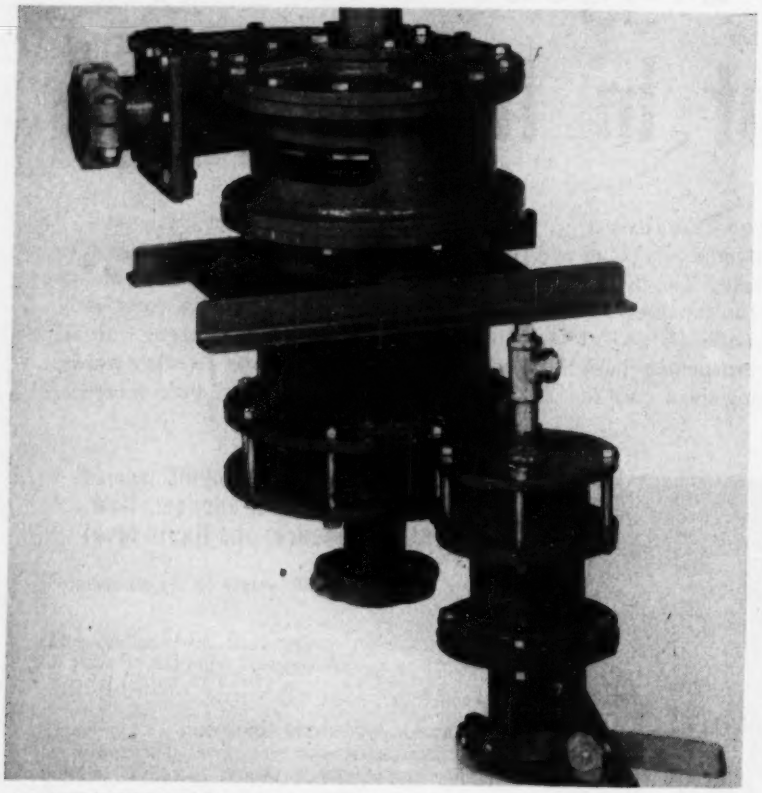
6.4.3R

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

NEW PROCESSING EQUIPMENT



FOR CLASSIFICATION and thickening, two stages boost efficiency in . . .

Cyclone Built Like a Barrel

Two-stage cylindrical cyclone offers high capacity and minimum wear at low pressure; virtually eliminates tramp oversize. It makes full use of true vortex.

Equipment Engineers' model EE two-stage liquid cyclone departs radically from the cone shape of conventional cyclones. The new unit is cylindrical; consists of integrated 10 x 18 in. primary and 4 x 10 in. secondary elements.

Cyclones function primarily as classifiers and thickeners. In this respect model EE is claimed to give better classification in the macro range than do conventional cones. High efficiency and capacity are obtained at low pressure. Wear is much less than with other types.

Five units are now in use on silica and fine sands in clay, copper ore, phosphate sands and coal. For the future the coal and alumina industries appear to offer excellent prospects for application of these cyclones.

▶**Developed as Offshoot** – Development of model EE grew out of investigations conducted on microsizing with the Centriclone (Chemical Engineering, Nov. 1953, p. 212). According to Helmholtz' laws of fluid mechanics a true vortex is a cylinder, not a cone. Thus cylindrical cyclones permit full utilization of the powerful angular velocity of the true vortex.

A cylinder develops less wall friction than a cone three times as long having the same volume and residence time. It has a shorter angular slurry path and dissipates less energy during densification in the orbit of highest angular velocity.

Kellogg Krebs of Equipment Engineers reasons that a conical cyclone dissipates energy by producing heat and wear. This happens when mineral particles are densified by high angular velocity within a confined conical zone.

Energy thus lost can be put to better use by avoiding the conical form. Resistance to the torque and normal dynamic pattern of a fluid vortex is thereby eliminated.

▶**More Useful Energy**–In operation of model EE this means that enough energy is conserved to allow two stage operation. As an example a slurry with 20 percent solids can be pumped into the primary cyclone at 20 psi. and the underflow delivered to the secondary cyclone at 18 psi. This pressure is a force of real magnitude on the small secondary unit; it provides a sharp increase in the angular velocity gradient. In other words despite a lower pressure in the secondary it is still sufficient to give increased centrifugal force in the smaller diameter unit.

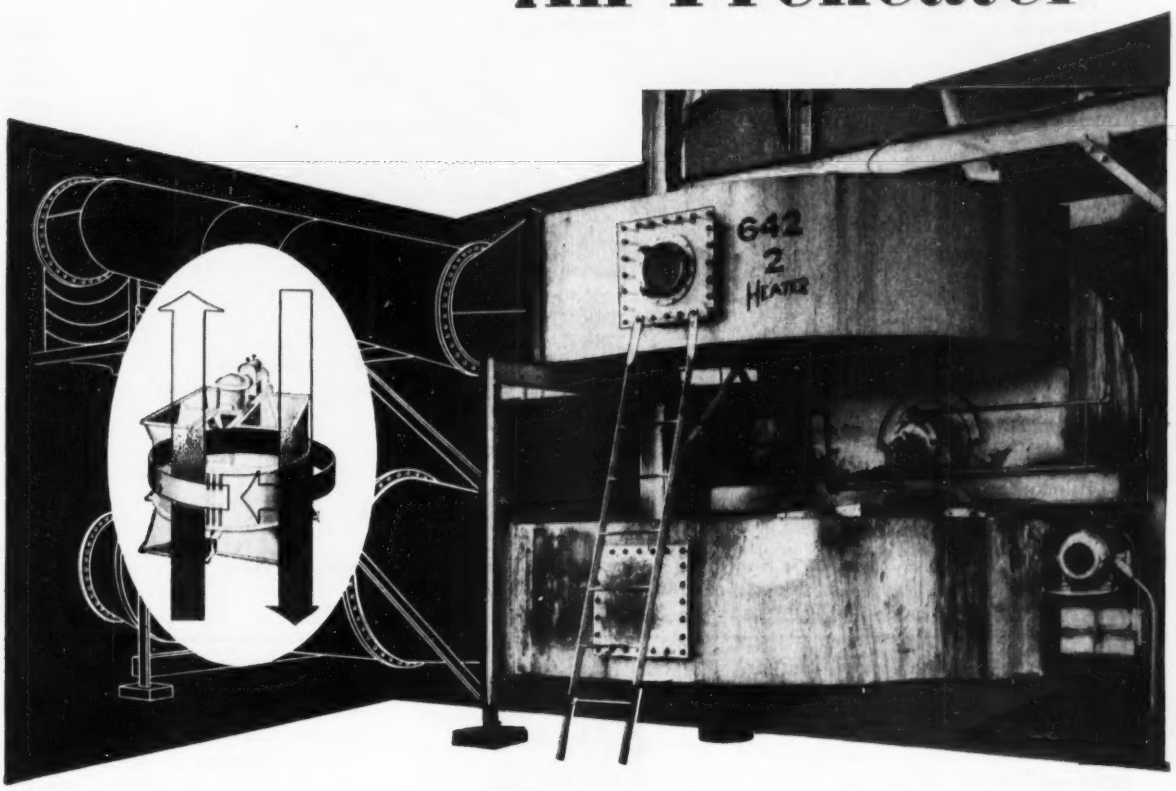
The second cyclone is actually a densifier. Maximum displacement of residual slimes is obtained. Some scattered top sizes are present in the secondary overflow but volume is small and much more dilute than primary feed. To secure optimum over-all clas-

Clean Desliming—Clay from Sand

	Feed	Overflow	Underflow
Gpm.	142	126	16
% Solids	27	17	74
Tons per hr.	10.5	5.0	5.5
Mesh	% Wt.	% Wt.	% Wt.
14	0.93		2.4
20	1.86		5.8
28	2.47		7.8
35	4.32		11.7
48	4.94		10.7
65	4.94		11.6
100	7.41		16.5
150	7.72		16.5
200	4.02		8.3
325	4.94	2.6	6.3
−325	56.45	97.4	2.4
Total	100.00	100.0	100.0

Replace Still Convection Surfaces...

...with a Ljungstrom Air Preheater



Wherever You Burn Fuel, You Need LJUNGSTROM

in purchasing new equipment — or modernizing existing equipment — one way to save impressive amounts of capital as well as operating expense is to design for a Ljungstrom Air Preheater.

Because the Ljungstrom promotes such greatly increased heat liberation in the furnace, the convection bank of oil tubes can generally be eliminated from the design. This can in itself *more than pay the cost of the Ljungstrom installation.*

Add to this the proved fuel savings ... the higher product quality ... greater throughout possible with a Ljungstrom — and you will see why the Ljungstrom is an eminently practical piece of equipment to be considered wherever fuel is burned.

In these days of high fuel costs and skyrocketing demands for petroleum products, every refinery should consider a Ljungstrom whenever equipment is being purchased or modernized. Call or write The Air Preheater Corporation for complete details.

THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.

This Equipment Made News This Month

Page and Code Number ↓

New Processing Equipment
- Two-stage cyclone 270A
- Dehumidifier for gases 272A
- Underdriven impeller 272B

New Instruments & Controls
- Liquid-level indicator 274A
- Protected flowmeter 274B
- Indicating flowmeter 274C
- Miniature venturi 274D
- High-output transistor 274E

New Fluids Handling Equipment
- Spring coupling 276A
- Chlorine pump 276B
- Graphite pumps 276C
- Compressor silencer 276D
- Rupture disk 276E
- Tubing fittings 276F

New Packaging & Handling Equipment
- Vapor cap 278A
- Filling machine 278B
- Filling machine 278C
- Freight drop 278D
- Fork lift trucks 278E
- Tractor shovel 278F
- Lift truck attachment 280A
- Weighing system 280B
- Polyethylene drum 280C
- Automatic scale 280D

Page and Code Number ↓

New Heating & Cooling Equipment
- Glass heat exchanger 282A
- Plant air conditioner 282B
- Freeze dryer 282C
- Infra-red heater 282D
- Smoke-killing system 282E

New Safety Equipment
- Paper work cap 284A
- Dry chemical extinguisher 284B
- Plastic safety lens 284C
- Neoprene clothing 284D
- Safety valve 284E
- Non-slip tool handles 284F
- Bottle carrier 284G

New Electrical & Mechanical Equipment
- Adjustable V-belt 286A
- Hydraulic jack 286B
- Refractory gun 286C
- Electric motor 286D
- Electric motor 286E
- Electric motor 286F

New Materials of Construction
- Glass pipe insulation 288A
- Metal primer 288B
- Metal roof deck 288C
- Graphite pipe 288D
- Floor drain pipe 288E
- Pipe insulation 288F
- Concentrator stack 288G

▶ For more information on any of these items circle number or reader service postcard inside back cover.

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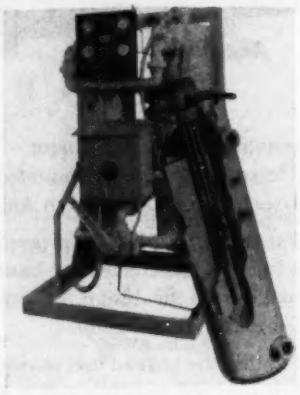
sification this overflow should be recycled to the feed.

▶ **Cleaner Cuts**—Cleanness of classification cut is shown by tabulated data above for a desliming operation at 325 mesh. At any desired cut the sum of pluses in the overflow and minuses in the underflow almost always is under 5. Separation efficiency approaches laboratory results. By contrast, for a typical cone cyclone the same combination will have twice this value.

One advantage of the cylindrical design is that dual overflows can be used on the primary, thereby increasing capacity by 20 percent or more. Another advantage is a claimed reduction in wear. All wear parts of model EE are made of pure, replaceable, molded gum rubber.

Model EE cyclones will be selling in the range from $750 to $900 for single and dual underflow units with capacities of 130-225 gpm.—**Equipment Engineers, Inc., 41 Sutter St., San Francisco, Calif.** **270A**



Dehumidifier Dries Compressed Gases

Cutaway picture above shows construction of the dehumidification chambers mounted on rack in background. Drying chambers remove moisture from air and other gases which are passed through a bed of solid desiccant contained therein.

Drying unit is fitted with dual chambers. While one chamber dries gas, the other regenerates.

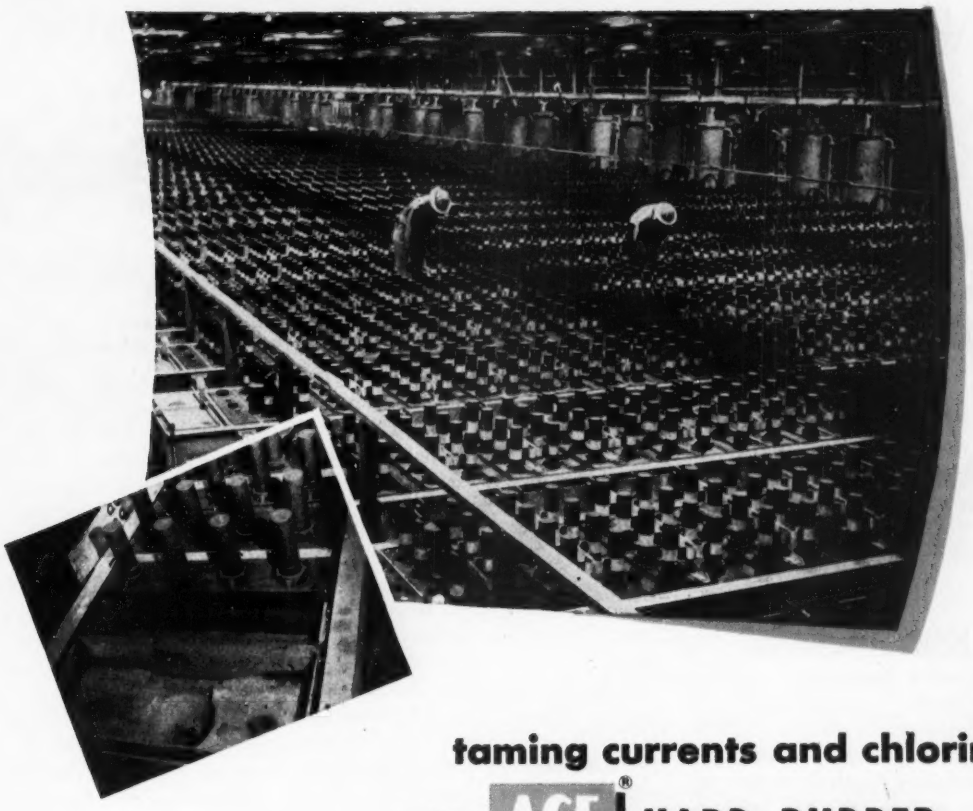
Each chamber is fitted with an internal heater to provide vaporization heat for the moisture held by the desiccant. Finned chamber design gives uniform heat distribution necessary for perfect desiccant regeneration. —**Industrol Corp., Roselle Park, N. J.** **272A**

Mixing Impeller Is Underdriven

A new bottom drive model of the Ultrafast Dissolver is said to eliminate aeration and permit easy pressurizing of the tank.

Motor is mounted beneath the bottom of the tank. Shaft bearing the impeller enters from that point.

Unit was developed as result of work on the blending of polyethylene and wax. It is available in a wide range of tank capacities and will be built to customer specifications.—**Cowles Co., Inc., Cayuga, N. Y.** **272B**



taming currents and chlorine

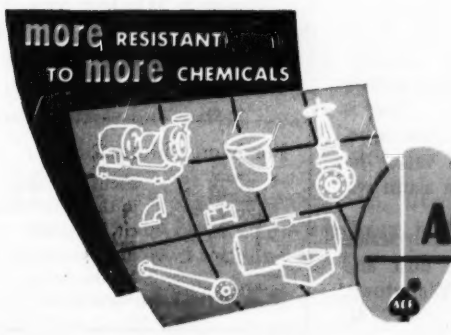
...with ACE® HARD RUBBER

Looks like a greenhouse, but the 2 acres of "flowerpots" you see here are actually DeNora cells, producing chlorine, caustic and hydrogen at the gigantic new Muscle Shoals plant operated by Monsanto Chemical Company for the Army Chemical Corps.

The covers for these cells posed a tough design problem. They support the heavy graphite electrodes, and must not sag or "creep." They seal in the gases, and must be corrosion resistant. Excellent electrical insulation is needed to prevent expensive current leakages. The covers should be strong and tough, yet light in weight for easy handling. Finally, materials costs must be relatively low, with efficient mass-production techniques.

After considerable study, based on experience with many materials, these covers were designed of solid molded ACE Hard Rubber.

This example is only one of hundreds of ways ACE rubber and plastic products serve and save in the chemical industry. ACE tanks, pumps, piping, valves, fittings, and molded parts are available in standard or special constructions for complete chemical processing, storage or circulating systems. Ask our engineers to recommend the most economical corrosion-resistant equipment for your processes.



ACE rubber and plastic products

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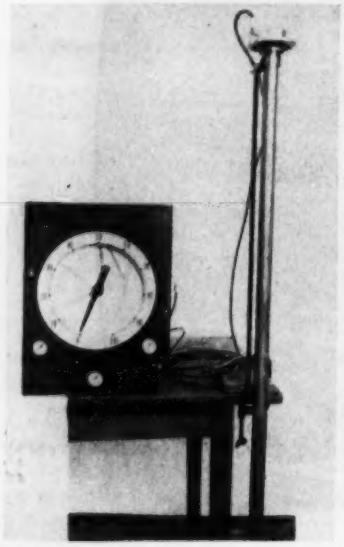


Liquid Level Indicator Works Near Absolute Zero

A recently developed low temperature instrument measures, indicates, records and controls the level of liquefied gases such as hydrogen, nitrogen, oxygen or helium. Device was evolved by National Bureau of Standards scientists and engineers of Brown Instrument Div. for the NBS-AEC Cryogenic Engineering Laboratory at Boulder, Colo. (Chemical Engineering, Nov. 1953, p. 134).

Sensing element of the instrument is a vertical cylindrical capacitor whose capacitance is a linear function of the height of the liquid within it. The capacitor forms one element of an a.c. bridge whose output indicates and records the electrical capacitance and thus the liquid level. Bridge output also controls a pneumatic valve which admits more liquid to the system when the level falls below a certain point.

A change in the capacitance of the sensing unit unbalances the bridge. The bridge output or signal voltage then may be reduced to zero. A slidewire resistor is adjusted until the bridge is again balanced. Position of the slider is linearly related to the capacitance of the sensing unit and therefore to the liquid level.

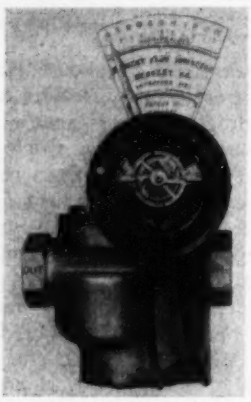
Rebalancing is automatic. The detector is a phase-sensitive amplifier whose output is determined by the amplitude and sign of the capacitive unbalance. Amplifier output energizes a two-phase induction motor which drives the slider on the resistor wire, restoring the bridge to balance.—**Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne & Roberts Ave., Philadelphia, Pa. 274A**

Glass Flowmeter Tube Protected from Breakage

Safeguard Rotameters are protected against external shock and tube breakage. A completely enclosed steel meter case, with detachable safety-glass windows, protects the glass metering tube.

Rigid construction gives precise end fitting alignment and eliminates pipe stresses on the Rotameter tube. Standardization permits use of four different tube sizes in one meter case. Also variety of rotor designs affords a wide range of capacities within one meter size.

Scales are available calibrated either in units of flow, or in millimeters for use with calibration charts.—**Schutte and Koerting Co., Dept. M-D Cornwells Hgts., Bucks County, Pa. 274B**

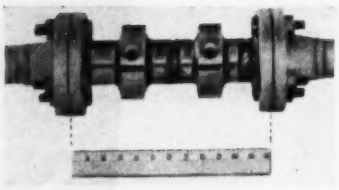


Indicating Flowmeter Actuates Alarm System

Installed right in the pipe line a new indicating flowmeter tells at a glance the liquid flow rate. The simple rugged construction has only three moving parts.

Desired flow rate may be set quickly on the face of the switch. Flow is indicated on a dial. When rate is below or above the desired value the Mercoid switch actuates an alarm system.

Switching mechanism is fully sealed for protection from dirt, dust and corrosion.—**Henszey Co., Watertown, Wis. 274C**



Venturi Tubes Offered in Miniature Size

Gas or liquid flows considered too small for metering with a normal-size venturi orifice can be handled with the type TF Venturi. Tubes may be furnished with inlet sizes of ½, ¾, 1, 1¼, 1½ and 2 in. There are four different ratios of throat to main in each of these sizes.

Component parts of the tube are welded together. Each part is machined to a tolerance of 0.005 in.

Tube is furnished with annular pressure equalizing rings at the point where the main and throat taps are located. Although usually equipped with flanged ends it can be provided with screwed ends for sleeve couplings if specified. Tube may be made of cast iron, stainless steel or bronze. —**Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa. 274D**

Transistor Gains In New Output Strength

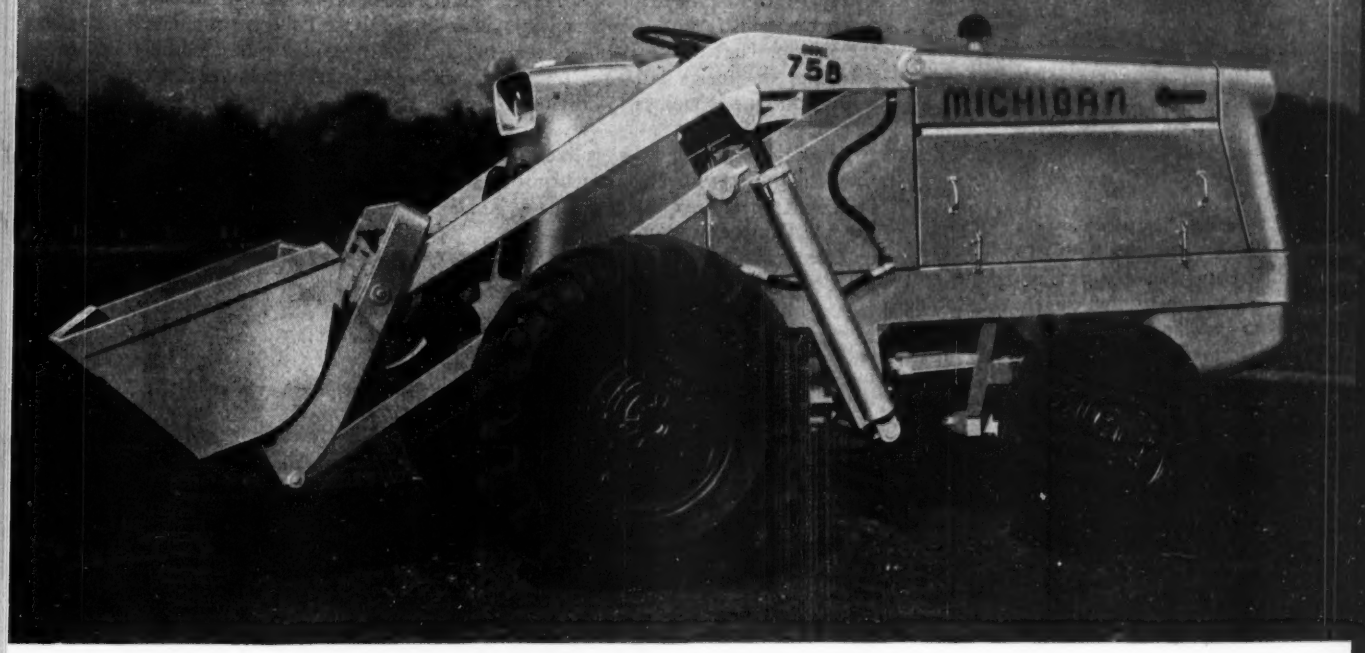
One problem with commercial transistors has been low output. A newly developed transistor has an output of 20 w., 100 times more powerful than previous models. This makes it possible for transistors to operate motors, valves, relays, etc.

Basic reason for previous low output has been the problem of heat. With the new unit an effective means has been discovered for removing heat from the germanium-alloy junction. —**Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa. 274E**

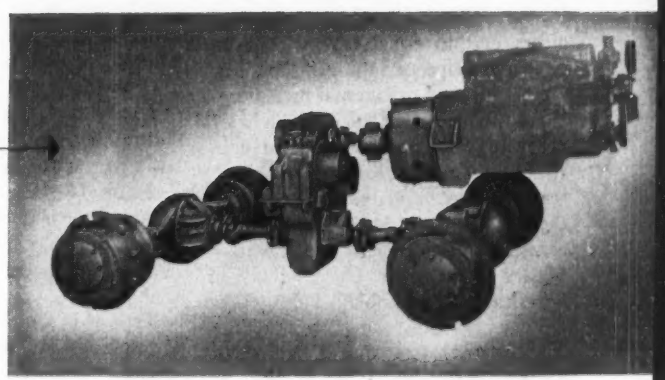
For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Here's Why The **MICHIGAN** *Tractor Shovel*
WILL DO MORE WORK FOR YOU!



* *This Power Train — from engine to tires — engineered and manufactured by Clark*



* **CLARK TORQUE CONVERTER** — 3-to-1 multiplication factor provides maximum torque *when it is needed.* Precise control in inching and digging.

* **CLARK POWER-SHIFT TRANSMISSION** —no conventional clutch; four speeds forward and reverse—direction control by lever on the steering column.

* **CLARK PLANETARY DRIVE AXLE** — final reduction in the wheel reduces the torque load on all gears and shafts.

RESULT — easier operation, utmost accessibility and simplicity of servicing, highest efficiency in shovel handling.

ADD greater weight and more horsepower than any front-end loaders of comparable capacity, and you see why you can Move More with a MICHIGAN*.

*A Trademark of Clark Equipment Company

For full information send for the MICHIGAN Tractor Shovel Fact-Folio —specifications, action photos, magazine article. The coupon will bring your copy.

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432 Second Street, Benton Harbor, Michigan, U. S. A.

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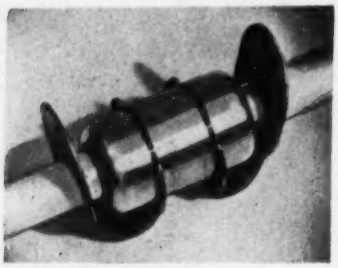


Spring Coupling
Is Simple and Foolproof

Using this spring coupling, the most inexperienced man can connect tubing or pipe in a matter of seconds. All you do is press the spring clip, insert the tube, release the spring, and your sealed connection is complete. No threads, flares, ferrules or tools are needed.

Coupling is claimed able to hold high pressures. Grooves at each end of the interior hold rubber, silicone or Teflon O-rings. Internal pressure deforms the rings, making the couplings self-sealing.

Coupling sleeve is tapered on the inside to allow for variations in the O.D. of the tubing or pipe. A stop in the center controls insertion from either end to equal lengths. Spring clip holds pipe or tubing in coupling against internal or external pressure.

Coupling will be available in wide range of sizes and materials of construction. It will also be available as tees, elbows, and connectors with threaded ends and hexagon outside for connecting into present equipment.—**Master Enterprise Corporation of America, Boulder Bldg., Tulsa, Okla. 276A**

Centrifugal Pump
Developed for Liquid Chlorine

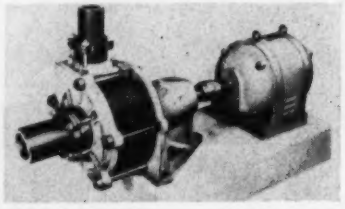
Dry chlorine can be handled with ordinary materials of construction. Once moisture gets into it, however, it can cause severe corrosion. Keeping moisture out has been a major problem in pumping dry liquid chlorine.

In the past dry chlorine has been moved by use of dry compressed air. Compression and dessication of air is expensive. Also pumping with air pressure is slow.

A satisfactory centrifugal pump design has been developed that completely excludes moisture from chlorine being handled.

Moving parts of the unit are immersed in the liquid. Rotor of motor is sealed into liquid system by a nonmagnetic stainless steel diaphragm in the air gap. Unit can be mounted on manholes in storage tank for transferring chlorine to tank cars, ton tanks or cylinders.

Pump is fitted with a bypass line so that chlorine continually recirculates holding temperature quite constant.—**Peerless Pump Div., Food Machinery & Chemical Corp., 301 West Ave. 26, Los Angeles 31, Calif. 276B**



Graphite Pumps
Now Practical for More Jobs

Two new models of the Karbate centrifugal pumps are practical for ordinary corrosive conditions as well as the severe conditions for which they already are noted. New pumps are easier to install, operate and maintain. They cover a wider capacity range.

Heavy-duty type C pump has an unusually high degree of parts standardization among pump sizes. Three basic sizes with discharge openings of 2, 3 and 4 in. can be furnished with either 10- or 8-in. impellers. All parts except the volute case, suction cover flange and impeller assembly are interchangeable.

Type F is a motor-mounted pump. It combines compactness and low cost of the close-coupled pump with operating and maintenance features of a top-quality frame-mounted pump.

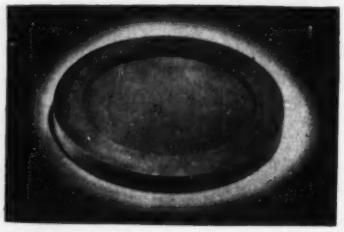
Pumps can handle capacities from 5 to 1,500 gpm. at discharge pressures to 1,000 psi.—**National Carbon Co., 30 East 42nd St., New York 17, N. Y. 276C**

New Silencer
Quiets Compressor Noise

Two new series of silencers are said to quiet the noise produced by air compressors, blowers, vacuum pumps and other machines expelling high velocity air to atmosphere. Silencers are designed for operation under moisture-free air conditions and for temperatures up to 200 deg. F.

Units are built with straight-through perforated tubes. Tube is surrounded by a deep layer of sound absorbing material. There is minimum restriction to air flow.

Series CA is available in pipe sizes up to 6 in.; series LCA is furnished in sizes larger than 6 in.—**Burgess-Manning Co., Libertyville, Ill. 276D**



Rupture Disk
For Corrosive Systems

Providing maximum resistance to highly corrosive liquids and gases, a new rupture disk is fabricated of Impervite graphite. At critical pressure, disk ruptures to release dangerous built-up pressure. Disk incorporates excellent thermal shock resistance as well as corrosion resistance.

Complete unit consists of a graphite ring and expendable disk. In a typical installation unit is attached between vessel nozzle and vent line of the system. It is available for nozzle sizes from 2 to 12 in.—**Falls Industries, Inc., Aurora Road, Solon, Ohio. 276E**

Brass Fittings
Connect Polyethylene Tubing

A complete line of Poly-Flo tube fittings are now available for connecting polyethylene and other plastic tubing. Fitting is installed rapidly and easily; needs only to be finger tightened.

Fitting is compression type consisting of a brass body with integral tube support, brass nut and polyethylene sleeve. Tube support in fitting permits sleeve to grip tubing securely.

Joint will hold burst pressures of 0.04 or 0.062 in. polyethylene tubing. Fittings available in two sizes are recommended for working pressures up to 125 psi. in $\frac{1}{4}$ in. O.D. and 100 psi. in $\frac{3}{8}$ in. O.D. size.—**The Imperial Brass Mfg. Co., 1200 West Harrison St., Chicago 7, Ill. 276F**

Continental's formula for drumming up business: SERVICE

You get more than lightweight, sturdy packaging when you buy Continental fibre drums. You get the *service* of Continental's nation-wide fibre drum division.

That means you have at your command Continental's experienced packaging engineers in twelve cities scattered all over the country. You have the use of Continental's research facilities. We will help you to test your packaging methods, to improve your old system or to establish a new and better system. We will help you to crack tough packaging "nuts". And don't forget Continental's quick deliveries to any point in the United States from our five fibre drum plants.

Call on Continental for packaging advice and efficient service!

A great new fibre drum plant in Pittsburg, California gives Continental a cross-country coverage unmatched by any other supplier.

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St. Louis, Missouri

From the wide variety of Continental fibre drums, you choose the size and style Tailor-Made for your product. Three bump-resistant, sure-locking, easy-opening styles: Leverpak, Stapak, Fiberpak. Your choice of many sizes, 17 different colors, 14 different inks. Special protective linings available for all of them.

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Oil Storage Vapor Cap Now on Market

Large-scale production and marketing of Microballoons is being undertaken by Bakelite Co. These tiny hollow phenolic resin spheres were developed recently by Standard Oil Co. of Ohio as an evaporation barrier for crude oil storage. Use of this material is claimed to cut evaporation loss by 80 to 90 percent.

Microballoons are installed in storage tanks by mixing them with oil and pumping them in. A layer ¼ to 1 in. thick will do the job. Evaporation savings will pay for installation cost in one year or less. Service life will be adequate to repay original cost several times over. Microballoon particles vary from 0.0002 to 0.0036 in. in diameter. The thin particle walls of phenolic plastic enclose inert nitrogen gas. Particles resemble finely ground dark flour and have a bulk density of approximately 8.7 lb. per cu. ft.—**Bakelite Co., Div. of Union Carbide & Carbon Corp., 260 Madison Ave., New York 16, N. Y.** 278A

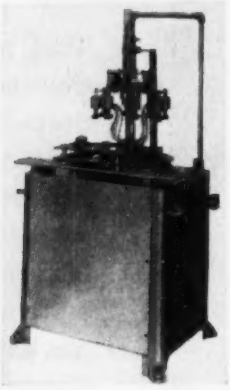
Can Filling Machine Applies and Seals Lids

A new fully automatic two-line filling machine fills one-half pint, quart and gallon cans. It can handle paint, oil, chemicals and similar viscous products. Lids are dispensed and pressed firmly in place following the filling operation.

Containers move only a minimum amount. They do not have to be raised or lowered for the filling, capping and pressing operation.

Production is from 20 to 50 cans per minute. Only one operator is necessary. Clean-up and changeover from one size container to another or one product to another can be made in a matter of minutes.

All contact parts are bronze, but stainless steel can be furnished on request. Hopper capacity is 33 gal. Casters can be provided to give mobility.—**The Filler Machine Co., Inc., Philmont Club Station, Pa.** 278B



Air in Containers Displaced by Nitrogen

Trapped air in filled containers of food or drug products frequently leads to spoilage. A new filling machine solves this problem by displacing the air with nitrogen.

A stainless steel nozzle on the automatic nitrogen depositing machine fits over the mouth of the container. A stream of nitrogen gas emitted downward from the nozzle forces trapped air out through a separate opening.

Machine is designed to keep loss of nitrogen gas to an absolute minimum. Nitrogen pressure is controllable and shuts off automatically when machine is stopped. Machine will handle containers from 1 oz. to several gallons.—**M. R. M. Co., Inc., 191 Berry St., Brooklyn 11, N. Y.** 278C

Counterweighted Load Drop Transfers Floor to Floor

Cylindrical loads can be lowered from one floor to another and discharged automatically by the Powerless Drop. Typical loads handled include drums, barrels, rolls of paper, cloth or rubber.

Installed in a shaftway the Powerless Drop operates on a simple counterweight principle; no power is required. Being vertical it needs a minimum of space. Also there is no problem of slowing down or stopping the load such as encountered with inclined chutes.

In operation, the load is rolled onto the carriage and the release lever pulled permitting the load to descend to the floor below. As the counterweight rises within a cylinder it is snubbed by an air cushion. When the load is released the counterweight returns the carriage to the loading position.

Rate of ascent and descent are controlled through regulation of the needle valve openings in the top and bottom of the counterweight cylinder. Air compressed within the cylinder by movement of the counterweight is released by bleeding through these openings.—**Gifford-Wood Co., Hudson, N. Y.** 278D

Conveyor Manufacturer Adds Fork Lift Line

Through acquisition of the Mobilift Corp., the Lamson Corp. now is in position to offer integrated materials handling systems. Such systems will be able to handle packaged products from the sealing machine through to the shipping platform and on into trucks, cars or storage.

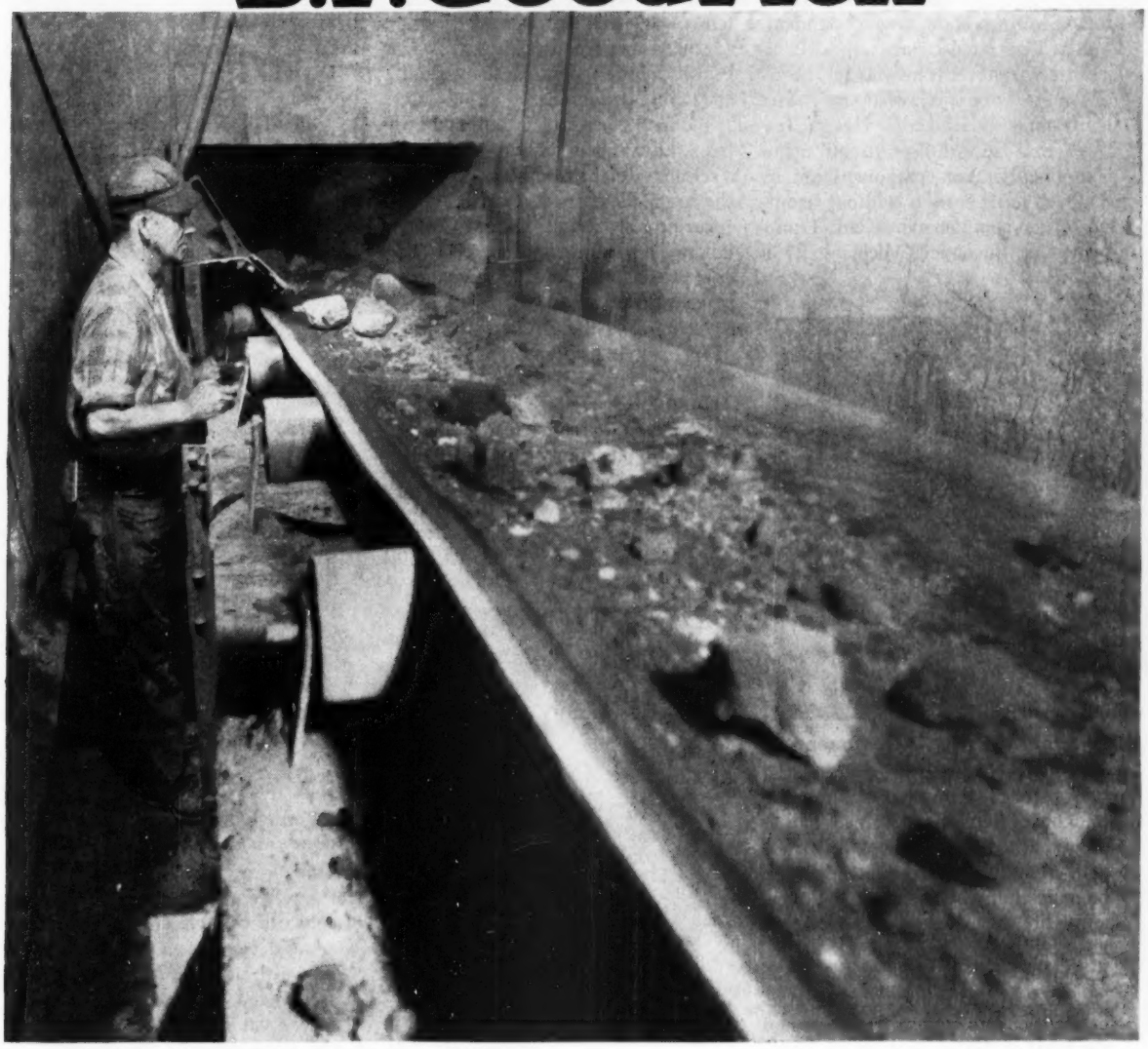
With Mobilit fork trucks added to its line of conveyors and pallet loaders Lamson can offer the proper combination of equipment for any application.—**Lamson Corp., Syracuse 1, N. Y.** 278E

Tractor Shovel Made in Range of Sizes

Six separate models launch a completely new line of tractor shovels or "front end loaders" for handling bulk materials. Three major types of design offer a combination of 2 or 4 wheel drive with rear or bucket-wheel steering. Capacities range from 15 cu. ft. to 2¼ cu. yd.

The torque converter transmission has a 3 to 1 torque multiplication fac-

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



Sizzling sand poured on rubber

A typical example of B.F.Goodrich improvement in rubber

STEAMING hot sand, from molds used to make steel castings, is dumped on this belt every few minutes.

Ordinary belts stood the sizzling sand for only 30 days. A belt made of woven asbestos lived a short, simmering life of 60 days. But even during this brief life, the belt had to have "first aid" every week — a dressing to protect it from the heat.

The company was far from satisfied. They asked about rubber, but every salesman said it couldn't stand the terrific heat. Every salesman, that is, but one.

A B.F.Goodrich man told them that his company had developed a special heat-resisting rubber for belts carrying such things as hot sand, lime, nitrates. Instead of ordinary fabric, they used *glass* fabric to make a belt that can stand heat as high as 500° F. Put to work here, the BFG belt outlasted all previous belts. It performed for two years — a ripe old age for a belt in a busy foundry that works 24 hours a day, 7 days a week.

New and improved products, like this hot material belt, are the result of the B. F. Goodrich emphasis on research — finding better and more economical ways of getting things done with industrial rubber products. That's why it pays to keep in touch with your BFG distributor for the latest ways to save with rubber. *The B. F. Goodrich Company, Dept. M-140, Akron, Ohio.*

B.F.Goodrich
INDUSTRIAL PRODUCTS DIVISION

tor. Steering boosters are standard.

Based on rated capacity the Michigan tractor shovel is heavier and develops more horsepower than any other comparable equipment. Design features easy accessibility to all major components. Any component can be removed in its entirety without removing other components.—**Clark Equipment Co., Buchanan, Mich.** **278F**

Hydraulic Truck-Attachment Dumps Drop-Bottom Boxes

Controlled dumping of drop-bottom boxes handling bulk materials is accomplished with a new fork-truck hydraulic attachment. Operation can be done at any height up to the maximum lift range of the truck without loss of lift.

A hook engages the rear end of the box and hydraulically raises it independent of fork action. The forks and the front of the box bottom are at the same height while dumping the load.

Device is attached easily and quickly to the truck. Lifting hook is adjustable and can be used with both 11 and 15 cu. ft. boxes. Hooks for other boxes can be furnished.—**The Yale & Towne Mfg. Co., Yale Materials Handling Div., Philadelphia, Pa.** **280A**

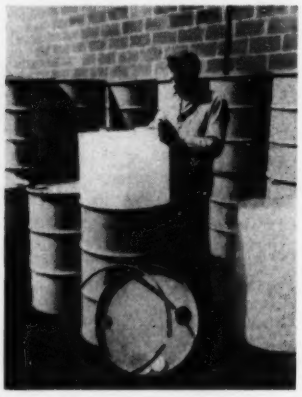
Synchromechanism Gives True Net Weight

In striving to eliminate waste, producers have focused part of their attention on packaging lines. They aim to give their customer the exact amount of product paid for, no more, no less.

A new automatic-tare weighing system makes this aim a reality. Using advanced instrumentation, the system brings hairline control to weighing and filling operations.

Product container is automatically tared, then filled with product until a selected weight is reached. In effect, the container serves as a weigh hopper. Inaccuracies, due to weigh hopper holdup, are eliminated thereby. Precise product weight in the container is recorded or printed.

Accuracy of the system rests on use of precise transducers consisting of military type synchromechanisms. Transducer cancels the unbalance in an electrical circuit created by the weight of the empty container. Synchromechanisms have a standard accuracy of one part in two thousand.—**Richardson Scale Co., Van Houten Ave., Clifton, N. J.** **280B**



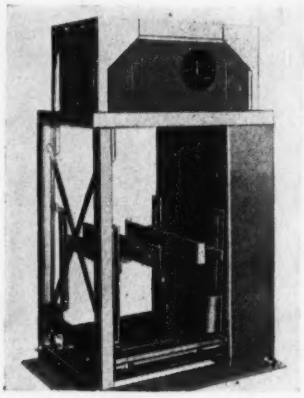
Polyethylene Drum Used for Corrosive Chemicals

One-piece molded polyethylene construction is used in a new line of light-weight shatterproof shipping drums. Designed to fit standard fiber, plywood and steel overpacks, the drums are available in 5, 15, 30 and 55-gal. sizes.

In a steel overpack the 15 gal. size is assigned about ½ the freight tariff usually assessed regular 13½ gal. carboys. A 55-gal. drum weighs ⅓ as much as 4 carboys.

Drums are suitable for such powerful industrial acids as muriatic and hydrofluoric, caustic soda solutions and electrolyte fluids. They are reusable without reconditioning.

Openings in the drums are made of two heavy-duty polyethylene flanges. Flanges are threaded to accommodate regular ¾ or 2-in. screw caps.—**Delaware Barrel & Drum Co., Inc., P. O. Box 1648, Wilmington, Del.** **280C**



Automatic Scale Checkweighs Filled Bags

Underweight bagged products mean customer complaint and ill will. Overweight can cut into your profits. You can avoid trouble on both counts by checkweighing filled bags before they pass to the bag sewing machine. Thayer's model 100S checkweight scale is designed to handle this job automatically.

A conveyor on the scale platform takes the incoming bag from the delivery conveyor and centers it on the platform. A photoelectric circuit stops the platform conveyor when the bag is centered. Weight is shown on large dials at each side of the scale.

If package is properly filled the conveyor automatically discharges the package to the sewing machine. In case of improper weight a horn sounds. Then the off-weight bag can be removed either by hand, by manual control of the conveyor or by manual pick-up after automatic discharge.

Model 100S can handle bags from 10 to 100 lb.—**Thayer Scale & Engineering Co., East Water St., Rockland, Mass.** **280D**

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about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

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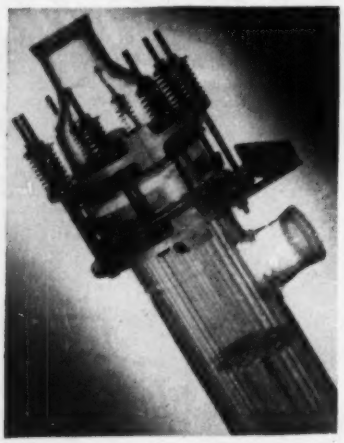


Shell and Tube Exchanger Shows Anti-Fouling Traits

Lack of product contamination and reduced fouling of heat transfer surfaces are twin virtues of the new Pyrex shell and tube heat exchanger. These advantages are gained through use of Pyrex brand glass and Teflon.

Interior of unit is completely visible. Fouling is detected at an early stage and removed by recirculation of acid.

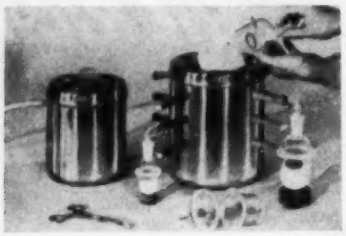
One unit of 50 sq. ft. requires floor space of 9 in. x 13 ft. 6 in., and 13 in. of vertical height. Both tube and shell side are designed for 20 psi. Maximum temperatures are 375 deg. F. tube side and 200 deg. F. shell side. Shell contains 26 tubes with a tube wall conductivity coefficient of 260 Btu. per hr. per sq. ft. per deg. F.—**Corning Glass Works, Corning, N. Y.** 282A

Packaged Air Conditioner Mounts on Roof

Good flexibility handling air conditioning jobs is provided by a new 2-ton refrigerating capacity roof unit. Single or multiple units can be positioned to meet requirements. They can be concentrated where the heat load is heavy.

Condenser is mounted on a hatch on the roof. Two stanchions extending through the roof support the evaporator in the space to be cooled below. Refrigerant circulates through the stanchions between evaporator and condenser.

Both parts of the unit are encased in aluminum jackets for long life. Air condensate is pumped to the roof and evaporated.—**Kritzer Products, 1234 West LeMoyne St., Chicago 22, Ill.** 282B



Freeze Drying Units Are Self-Contained

Compact new freeze drying units are being built either in glass or stainless steel. Dryers are designed to process small to medium quantities of bacteria, plasma, antibiotics, germs, viruses, hormones and other labile pharmaceuticals and biologicals.

Both units are completely self-contained eliminating the need for conventional dry ice chambers.

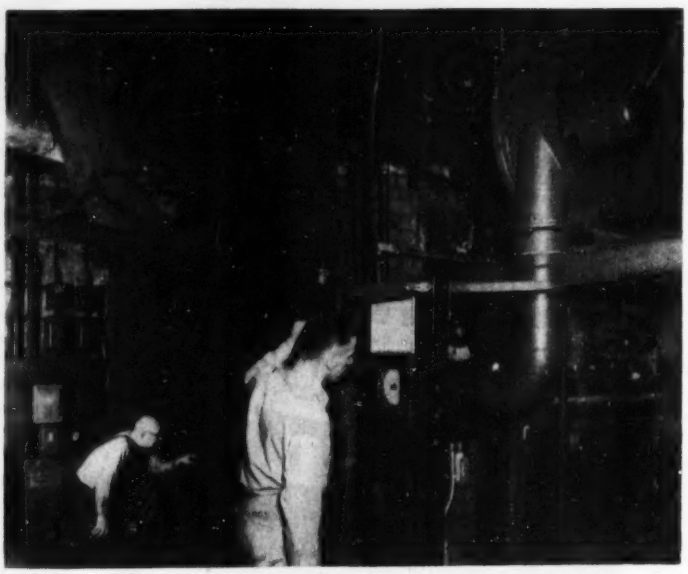
The 18-8 stainless steel dryer incorporates 14 taps. Two taps are for vacuum pump and gage while twelve taps, baffled to prevent clogging, are for drying flasks. Each tap is capable of removing a minimum of 100 ml. of water. The 2.8 l. cooling chamber holds enough dry ice and solvent for unattended overnight operation.

Standing only 21 in. high the all-glass unit is equipped with three drying ports. An additional port is used either for drying or for a drip trap.—**E. Machlett & Son, 220 East 23rd St., New York 10, N. Y.** 282C

Radiant Heater Emits Far Infra-red Rays

Far infra-red radiant heat is emitted by a new electric heating element. This type of radiation has good uniformity. It is readily absorbed by materials and substances being heated.

The single heating unit consists of a nickel alloy heating element encased in a fused quartz tube. Unit is completely sealed and acid-proof. Each heating element has an individual stainless steel reflector. Capacities range from 100 to 1,000 w. per linear ft.—**Cleveland Process Co., 1965 East 57th St., Cleveland 3, Ohio.** 282D



OVER-FIRE AIR SYSTEM PREVENTS SMOKE POLLUTION

By teaming together a smoke detector, a blower and a set of air distribution nozzles this furnace is being operated without violating smoke ordinances. Periodically, quantities of combustible waste are burned on the fuel bed of the coal-fired furnace. Increased smoke density then is detected by a photoelectric unit which actuates the blower. Extra supply of air delivered from blower through nozzles into furnace permits more complete combustion and elimination of smoke. Recorder gives visual and permanent record of operation.—Sterns-Flinn Corp., 30 Church St., New York, N. Y. 282E

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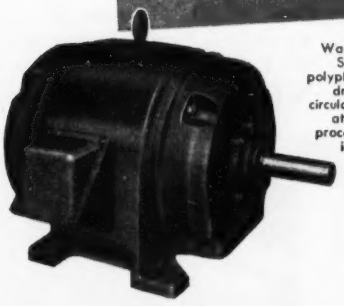
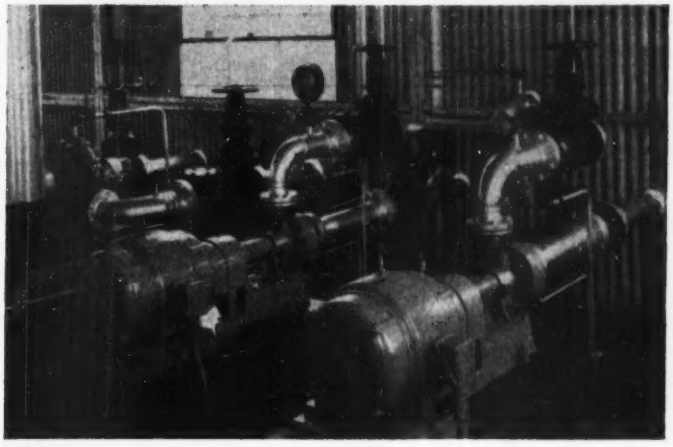
ELECTRIC MOTORS
... the choice of leaders in industry

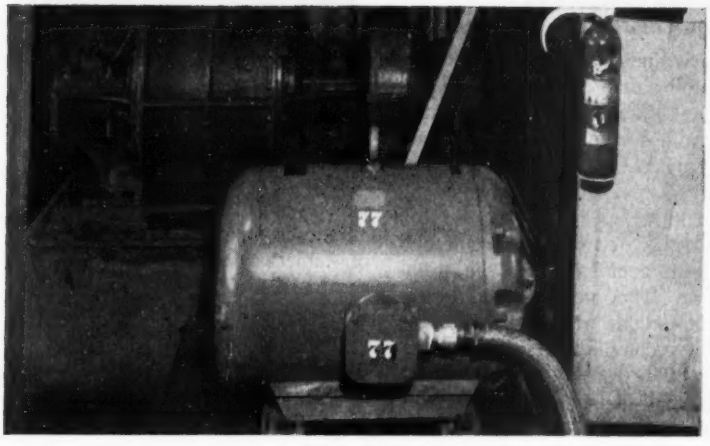
You can *depend* on Wagner Motors to furnish *PLENTY OF POWER* for compressors, pumps or blowers

PUMPS

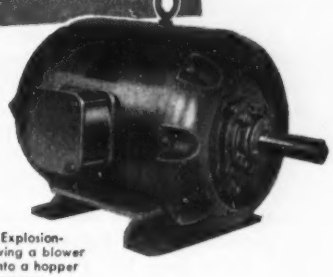


Wagner 15 hp Splash-proof polyphase motors driving water circulating pumps at a large oil processing plant in Louisiana.





BLOWERS



Wagner 40 hp Explosion-proof motor driving a blower to draw grain into a hopper at a Southern brewery.

Motors that drive compressors, pumps and blowers need plenty of electrical and mechanical stamina to hold up under the hard, steady grind demanded by these applications.

Selecting the right motor for such equipment is not a problem of procuring specially built motors, but of choosing a standard Wagner Motor suited to the job. Wagner Motors are diversified in design and can be readily adapted to a wide range of compressor, pump and blower applications.

Improve the performance of your equipment by choosing Wagner Motors to power your compressors, pumps and blowers.

Bulletin MU-185 gives information on the complete line. Let a skilled Wagner engineer discuss your motor needs with you. Just call the nearest of our 32 branch offices, or write us.

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M54-6A

Paper Work Cap Replaces Cloth Cap

Many chemical companies require plant personnel to wear some sort of cap or hat for head protection. Cloth cap normally used can be replaced by a neoprene paper cap with savings up to 30 percent.

Cap was developed by DuPont safety engineers for use in one of the Company's large chemical plants. Made of neoprene-treated heavy kraft paper, the cap is water repellent and flame resistant. Also it is resistant to both acids and alkalis.

Experience has shown that cloth caps intended for laundering and reuse actually were discarded when soiled. Once they were laundered appearance was too shabby to be tolerated by workmen.

On this basis paper cap can compete with cloth cap and show a 30 percent saving.—**Record Industrial Co., 3301 Arch St., Philadelphia 4, Pa.** 284A

Dry Chemical Extinguisher Has Non-Fouling Valve

Quick-acting, positive valve seating at all times is claimed for the Redi-Flow Mark II dry-chemical stored pressure fire extinguisher. Spherical design of the discharge valve prevents fouling from dry chemical particles. Accidental distortion of the valve's mechanism will not interfere with valve operation.

Valve holds pressure so well that extinguisher is effective even after partial discharge.

Extinguisher can be operated with one hand. A one-hand squeeze grip incorporates a lever-locking cam that is released quickly by pulling back with the thumb.

Mark II extinguishers now are supplied in 3, 4, 5, 10 and 20 lb. capacities. A 30-lb. unit will be available shortly.—**Stop Fire, Inc., 125 Ashland Pla., Brooklyn 1, N. Y.** 284B

Plastic Safety Lens Resists Scratching

Optilite A safety lens has an extremely hard surface. Result is super scratch resistance and longer life. Lens weighs only one-half as much as safety glass.

An alternate plastic formula, Optilite B, can be furnished where low cost is desired. It is recommended for operations where lens life is short.

Lenses will fit any standard industrial spectacle frame; will meet federal specifications for impact and optical quality.—**United States Safety Service Co., 215 McGee, Kansas City 6, Mo.** 284C

Neoprene Clothing Is Tough, Comfortable and Flexible

A new line of neoprene latex clothing in olive drab color is built to protect the wearer from rain, salt water, acid, paint, grease, oil, gasoline, alkali, etc. Service life is said to be two or three times more than rubber or oilskin clothing.

Garments are coated inside and outside with neoprene after the seams are sewn. They are tough and flexible yet comfortable and cool. Cleaning may be accomplished simply by rinsing in a petroleum solvent cleaner shaking and hanging out briefly.

Garments are available in two weights; a heavy for severe work and long service and a medium for those desiring something thinner, cooler and cheaper.—**M. L. Snyder & Son, Boston Ave., Philadelphi 25, Pa.** 284D

Safety Valve Acts as Depressurizer

In case of an emergency the Remoter depressurizing safety valve acts rapidly to depressurize pressure vessels. Also it can function as an unloader for those applications where the unloading feature can be combined with a safety valve.

Depressurizing component of the Remoter is interchangeable. It can be mounted readily on safety valves which are already installed.

Remoter will operate efficiently under all conditions including fire, freezing and current failure. It can be operated by air pressure from remote points; can rapidly depressurize vessels to a predetermined limit or to atmospheric pressure.

Valves are available with standard depressurizing motors in valve sizes from 1 x 1½ to 2½ x 4 in. Valves in sizes from 3 x 4 to 8 x 10 in. are provided with extra-power depressurizing motors.—**Farris Engineering Corp., 501 Commercial Ave., Palisades Park, N. J.** 284E

Vacuum Grip Handles Overcome Slipping Danger

Acting on evidence from hand tool accidents, one company has designed vacuum grip handles for its line of striking tools.

Grip is improved by the presence of numerous conical impressions on the tool handle. These create a suction between the hand and the handle. Slipping problem is claimed minimized even with oily or greasy hands. —**Ampco Metal, Inc., 1745 South 38th St., Milwaukee 46, Wis.** 284F

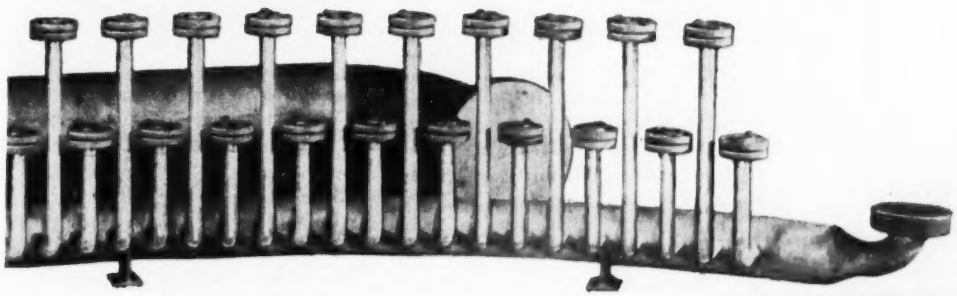
Bottle Carrier Protects Men from Injury

Danger associated with carrying large acid bottles can be eliminated with the Agilene bottle carrier. Made of corrosion-resistant polyethylene it is light in weight and unbreakable.

A bail-type handle is provided. The snug-fitting cover holds bottle safely in position even when tilted for pouring. Bottleneck extends through hole in top of cover.

An over-size carrier can be used for transporting iced samples of monomers or reagents. Excess space between the sample bottle and the wall of the carrier can be filled with cooling mixture.—**American Agile Corp., P. O. Box 168, Bedford, Ohio.** 284G

It Takes GOOD TUBING *To Make* GOOD PIPING...



and WELDCO *Makes Only the Best!*

The stainless steel piping, shown in the photo above, required the best tubing available. WELDCO was chosen for this important job because it met the rigid specifications of the buyer. It was selected, also, because of its excellent fabricating qualities . . . easy to bend, form, weld and assemble.

WELDCO is lightweight and corrosion-resistant . . . has a smooth inside finish, exceptional strength, and complete uniformity throughout. It's available in Stainless Steel, Monel, Hastelloy, Inconel, Nickel, and Cupro-Nickel, in tube and pipe sizes from 3" to 30", Schedules 5 and 10, and 3" to 12", Schedule 40.

Whenever you need dependable tubing for special problems — or for regular applications — specify WELDCO, your best buy in top-quality tubing.

Whatever Your Needs In Tubing . . . . You're 'Way Ahead With WELDCO

THE YOUNGSTOWN WELDING & ENGINEERING CO.

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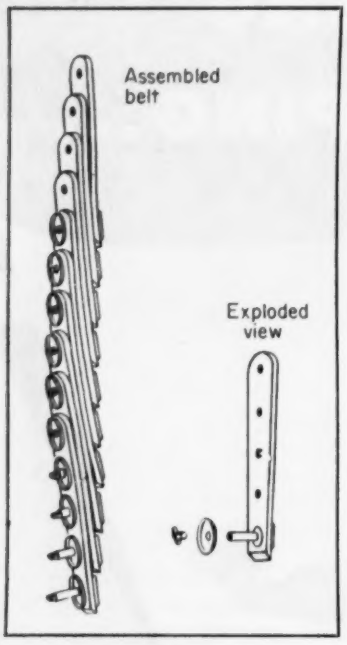


New Adjustable V-Belt Couples With Great Ease

Veelos adjustable V-belts TD and TE for D and E drives offer new ease of coupling and uncoupling together with greater strength and durability.

Belts are made of plys of treated high-tensile strength canvas duck. Individual links are designed for greater strength and beveled for flexibility.

Plys are joined by riveted studs with removable cup-washers and T-screws. Studs are anchored permanently in links for added durability. Cup washers are shaped to resist belt wear. Strong T-screws are made for easy coupling and uncoupling.

Belts are available in two types: Regular rubber coated for general service and oil-proof for oily and high temperature drives.—**Manheim Mfg. & Belting Co., Manheim, Pa.** 286A

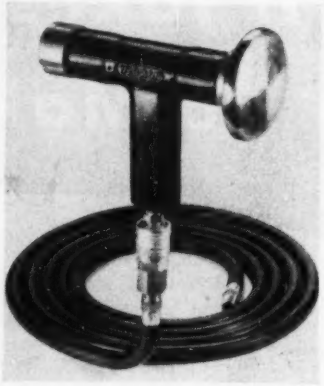
For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Air Motor Powers Hydraulic Jack

Compressed air at 80 to 100 psi. is used to operate a new type hydraulic jack. The air operates an air motor connected to the pump of the hydraulic system. Combination is said to save both time and labor.

A choice of four hydraulic rams can move 30 tons in any direction a distance of 2, 3½, 6 and 20 in. Air motor and pump are mounted on a portable buggy.—**Duff-Norton Mfg. Co., 2710 Preble Ave., Pittsburgh 12, Pa.** 286B

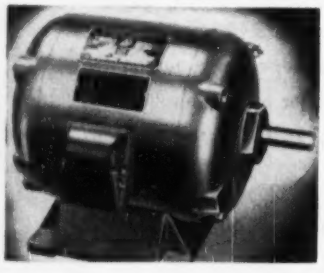


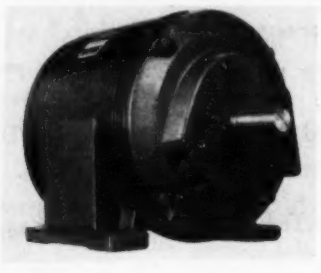
Refractory Gun Reduces Patching Cost

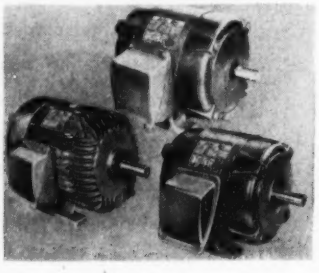
Time-consuming refractory lining and patching jobs can be handled faster and cheaper with a pneumatic refractory gun. Linings and patches can be applied with 40 to 50 percent less moisture; thus have longer life. Also lining shrinkage and drying time are reduced.

Gun heads are two different sizes. Strokes at the rate of 4,800 per min. are produced by a piston reciprocating in a cylinder between two heads. Piston pushes against air cushion which makes for quiet operation of vibrating impact tool.

Air supply must be between 85 and 130 psi. Weight of Bantam gun is 5 lb.—**Vibron Div., Burgess-Sterbentz Corp., 3790 West 150th St., Cleveland 11, Ohio.** 286C







How Motors From Different Builders Look Under New Code

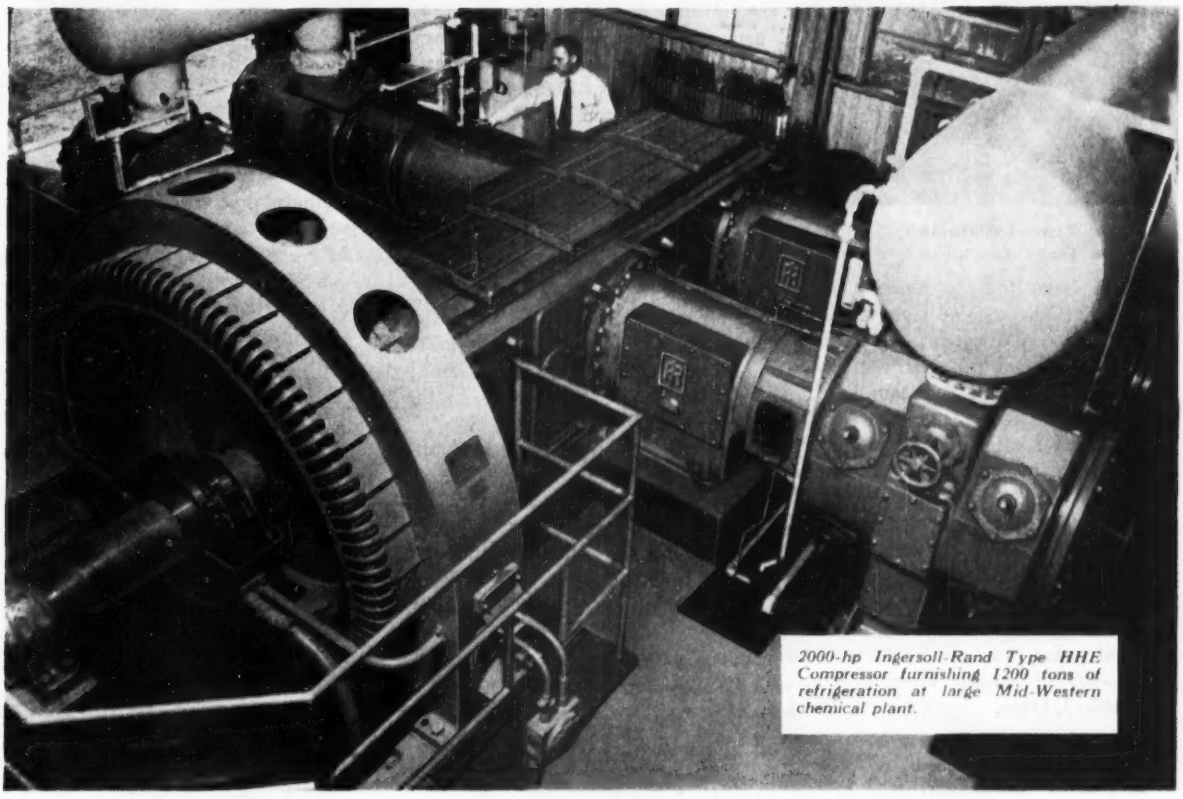
This line is offered to the user in either old or new mountings. Contour lines and styling will be the same as the old design. Drip proof model features maximum ventilation.—A. O. Smith Corp., Box 584, Milwaukee 1, Wis. 286D

Better protection of motor windings, leads, and bearings is gained by users of this motor. New open design is highly protected; TEFC design can run in any position.—Reliance Electric & Engineering Co., Cleveland 10, Ohio. 286E

Longer insulation life, good ventilation and better drip protection, more effective bearing seals and TEFC pressure-equalizer bypass to guard bearings are found in this line.—Westinghouse Electric Corp., Pittsburgh 30, Pa. 286F

5 YEARS OF CONTINUOUS SERVICE

with practically No Maintenance



2000-hp Ingersoll-Rand Type HHE Compressor furnishing 1200 tons of refrigeration at large Mid-Western chemical plant.

2000-hp ammonia compressor gives outstanding performance at large chemical plant

Installed in 1949 this heavy-duty Ingersoll-Rand compressor has been in continuous service supplying 1200 tons of refrigeration for a large Mid-Western chemical plant. Driven by a 2000-hp synchronous motor, it compresses ammonia in two stages from 11 psig to 215 psig. During these five years' operation there has been practically no maintenance or replacement of parts.

Based on this outstanding performance record, the company has recently installed a 3000-hp air compressor of the same fundamental design, thus taking advantage of the interchangeability of most of the wearing parts. 1-50

If you have processes calling for compression or evacuation of air or gas you can surely benefit from Ingersoll-Rand's experience in designing and building the world's most complete line of reciprocating and centrifugal compressors. Your I-R engineer is well qualified to give you expert assistance, no matter what the gas, pressure, temperature or process.

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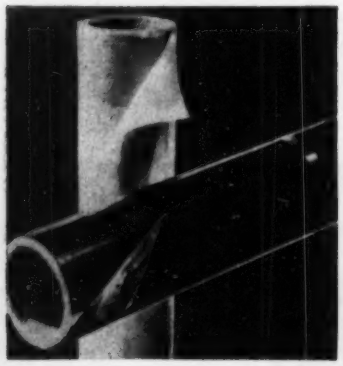


Glass Pipe Insulation
Stops Heat Leakage

Extra heat stoppage value is claimed for a new low pressure pipe insulation constructed of Fiberglas. This material is designed for cold water, hot water, or low-pressure steam lines.

Insulation is available with canvas covering for hot water or low-pressure lines. For installations on cold water lines a jacket of asphalt-saturated kraft paper protects against condensation.

Primarily this new pipe insulation is intended for indoor applications. However, with addition of a waterproof jacket it is suitable for outdoor use.—**Owens-Corning Fiberglas Corp., Toledo 1, Ohio.** **288A**

Rusty Metal Primer
Replaces Sandblasting

Rusty metal surfaces now can be painted without need for preliminary sandblasting. A new rusty metal primer makes an effective undercoat for vinyl-resin base protective topcoating. A group of tanks at a plant in St. Louis are still in first-class condition 18 month after treatment.

Loose rust and scale are first removed from the tank surfaces. This is followed with one coat of the rusty metal primer and two coats of anticorrosion coating based on vinyl resin. —**Surface Engineering Co., Inc., 1535 Barwise Ave., Wichita 1, Kansas.** **288B**

Metal Roof Deck
Guarded by Vapor Barrier

A recently announced metal roof deck for heavy industry is fully protected against corrosive influences and high humidity conditions. Three protective coatings are applied to the steel; a bond coat, a weather-sealed asphaltic plastic coating and a pure mineral mica topping.

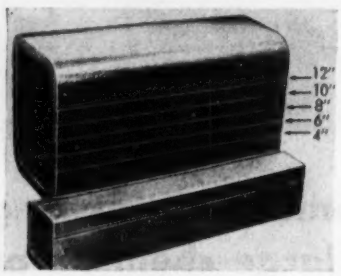
Roof deck panels are 24 in. wide. Telescoping ends provide for snug nesting of end laps and give a smooth unbroken roof surface. Sound absorbent qualities reduce dangerous reverberent noise prevalent in ordinary metal roof deck.—**Plasteel Products Corp., Washington, Pa.** **288C**

Graphite Pipe
Used for High Temperature

Graphite pipe now is being fabricated to withstand temperatures up to 750 deg. F. High temperature is possible because a resin-free dense form of impervious graphite is used.

Pipe up to 4 in. I.D. made of Graphi-I-Tite, together with fittings of the same material, now is available.

Material also is used in shell and tube heat exchangers up to 100 sq. ft. transfer area. Tube, tube sheets, and channel are fabricated of the Graphi-I-Tite, while steel is used for the shell. —**Falls Industries, Inc., Aurora Road, Solon, Ohio.** **288D**



Floor Drain Pipe
Can Be Tailored on Job

Channel pipe designed especially for sloping drains and gutters in chemical plants is made of vitrified clay. It can be tailored on the job to fit drain depths from 4 to 12 in.

As delivered Chemi-Drain looks like rectangular sewer pipe. Each side of the pipe has five grooves.

Pipe is separated into channel sections by sharp blows in the grooves.

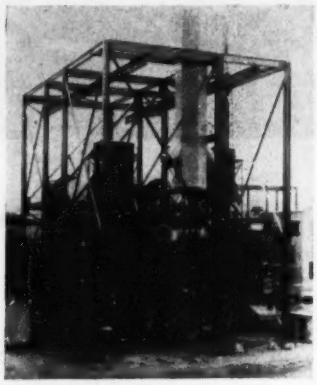
Curved tile covers the upper edges of the channel pipe making the installation flush with the floor. Drain then can be covered either with a metal grill or a solid floor plate.—**The Logan Clay Products Co., Logan, Ohio.** **288E**

Pipe Insulation
Has Integral Aluminum Jacket

Foamglas pipe covering now is furnished with an integral aluminum jacket. This change eliminates costly installation steps; gives you moisture-proof insulation, weatherproof jacket, and attractive finish all in one.

To install; slip covering around pipe and apply bands at segment joints and center. Refrigerated lines need joint-sealing compound.

Aluminum jacketed Foamglas is available in six thicknesses for pipe sizes up to 14 in. Range of thicknesses makes insulation usable from minus 50 to 800 deg. F.—**Pittsburgh Corning Corp., 1 Gateway Center, Pittsburgh 22, Pa.** **288F**



Concentrator Stack
Handles Hydrofluoric Fumes

This concentrator stack in a Southern chemical company is fabricated of a polyester laminate. Special reinforcement of Fiberglas and cotton was used in the fabrication.

Stack measures 32 ft. high and has a diameter of 5 ft. It was fabricated to specification in three sections and shipped to the plant by flat car. Joints for assembly of the sections were made at the site.—**Schori Process Div., Ferro-Co. Corp., 8-11 43rd Rd., Long Island City 1, N. Y.** **288G**

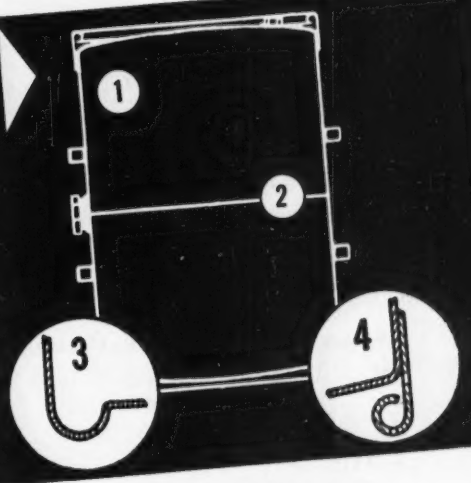
inside and outside

HACKNEY TWO-PIECE ACID DRUMS

...are designed to protect your shipments of corrosive and poisonous chemicals

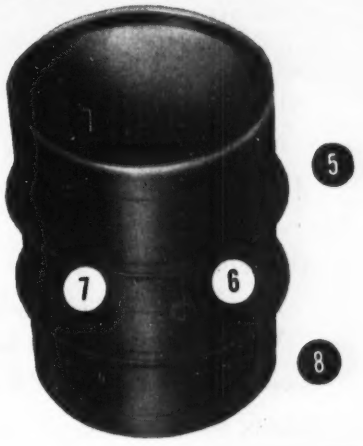
INSIDE

1. Smoother interiors are exceptionally easy to clean—are free from cracks and crevices.
2. This extra-smooth butt weld joins the two entirely seamless halves of the drum.
3. Here is the seamless formed chime used on the 15-, 20, and 30-gallon sizes.
4. Here is the seamless, reinforced chime construction for the larger 55- and 110-gallon sizes.



OUTSIDE

5. Sturdy I-Bar rolling hoops—protect the seam and spud against hard knocks.
6. Heavy, forged spud is firmly welded—becomes an integral part of the drum itself.
7. Two-piece construction eliminates head and longitudinal seams (no crevice corrosion), increases strength and shock resistance.
8. Heavy, curled foot ring reinforces chime on the larger sizes—withstands transportation abuse.



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PICTURED FLOWSHEET

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Oxalic acid from formate.

Here's how Oldbury turns out this organic acid by the synthetic formate process. Last year's output of oxalic came to 10,800 tons. *(Flowsheet)*

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In hot ammoniacal solutions, CITRIC ACID is an excellent rust and scale remover, resulting in the least possible loss of metal. Both Citric and Gluconic Acids make good sequestering agents forming stable water soluble complexes with calcium and iron. Citric Acid is available in both anhydrous and hydrous forms. A white crystalline powder, it is available in a number of mesh sizes.

GLUCONIC ACID

GLUCONIC ACID is a mild acid with an extremely low order of toxicity which makes it ideally suited for cleaning process equipment that comes in contact with foods. Noncorrosive, it is easy on equipment. Besides removing mineral deposits, the acid film remaining after its use retards the growth of certain types of bacteria. Gluconic Acid is marketed as a 50 percent aqueous solution. It is a light brown, slightly viscous liquid with an acetous odor.

CREAM OF TARTAR

(Potassium Acid Tartrate)

A slurry of CREAM OF TARTAR is an ideal cleaner for brass. The small crystals are hard and sharp, and mildly acidic providing a highly efficient cleaner. Cream of Tartar is marketed as a white crystalline powder. It has limited solubility in water and, for all practical purposes, is insoluble in alcohol.

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From one source . . . any instrumentation you need

When it comes to measurement and control, every industrial process is different. Each demands its own combination of accuracy, economy, instrument ranges, and all the numerous other characteristics that are peculiar to the individual application.

No single instrument and its accessories could possibly fit every process. So Honeywell makes a broad variety of measuring and controlling equipment that spreads across a tremendous range of applications.

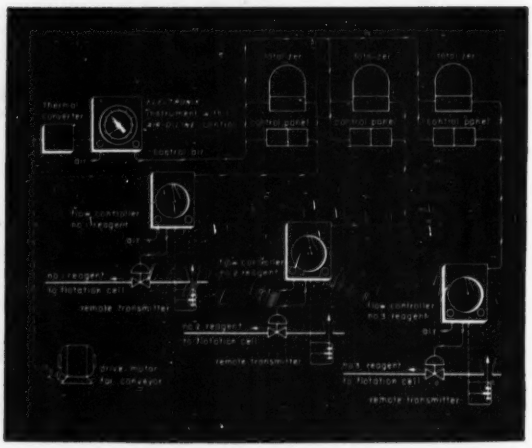
The advantages are two-fold. First, you can get all the instrumentation your process requires from a single source, so there is undivided responsibility for the complete installation. And second, you are assured that the equipment selected for your process is recommended without bias . . . neither over-sells nor under-equips . . . needs no stretching, squeezing or compromising to fit it to its assignment.

This versatile family includes *ElectroniK* indicators, recorders and controllers in circular and strip chart models, applicable to temperature, pressure, pH, power and dozens of other variables; square root flow meters for control applications; evenly graduated flow meters for cost accounting; thermometers, pressure gauges and liquid level meters; *Pyr-O-Vane* millivoltmeter controllers. Especially useful for graphic panels are the *Tel-O-Set* miniature indicators, recorders and controllers. Electric and pneumatic control systems range from the simplest to the most complex, including automatic program controls and complete systems developed for particular processes.

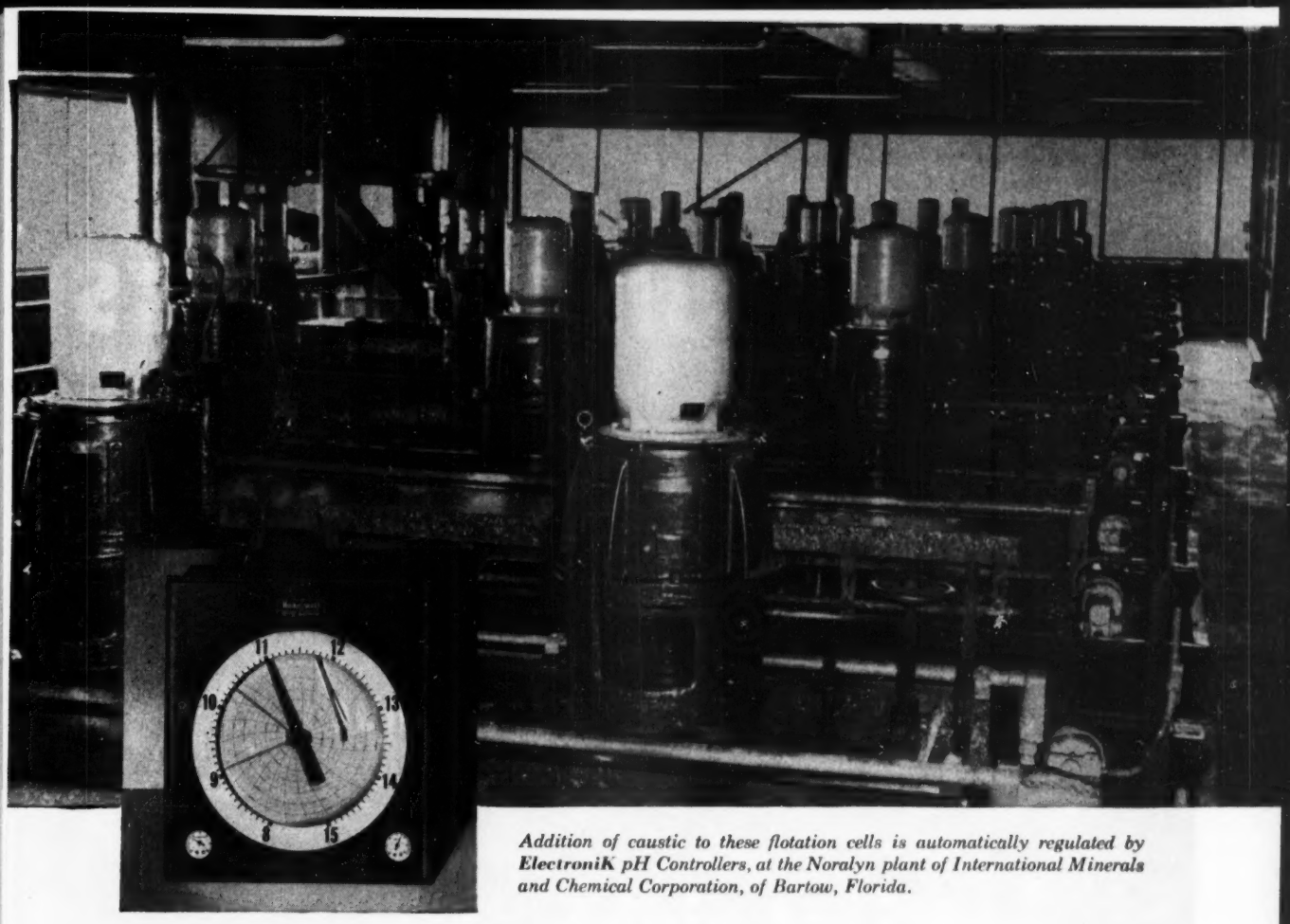
Working with these instruments is a full choice of primary elements . . . thermocouples, *Radiamatic* radiation elements, pressure-type and electrical resistance thermal systems, flow meter bodies, pH cells and many others. For final control elements, you can choose from a wide range of electric motorized and diaphragm operated valves. To complete the picture, there are more than 7000 non-indicating devices for controlling temperature, pressure, vacuum, liquid level and humidity . . . an unmatched variety of instrumentation made by the world's largest manufacturer of control equipment.

ElectroniK

pH control helps increase the yield from



Schematic diagram of pH control system for addition of caustic to phosphate flotation process.



Addition of caustic to these flotation cells is automatically regulated by ***ElectroniK*** *pH Controllers, at the Noralyn plant of International Minerals and Chemical Corporation, of Bartow, Florida.*

phosphate ore beneficiation

THE APPLICATIONS of *ElectroniK* instrumentation to the beneficiation of phosphate ore, at International Minerals and Chemical Corporation, demonstrate how modern control techniques help make heavy chemical processing more automatic . . . more efficient.

The flotation process, where silica sand is removed from the phosphate slurry, operates best within close pH limits. Through the use of an *ElectroniK* pH Controller, caustic is automatically added at the proper rate to maintain the desired alkalinity. A sample of slurry is continuously withdrawn from one of the flotation cells, and the liquid is passed through a pH electrode assembly. Connected to this detecting element through an amplifier is an *ElectroniK* instrument, which records the pH value and, through its *Air-O-Line* control, resets a caustic flow controller.

The complete system provides sensitive, accurate adjustment of caustic flow . . . holds pH well within the desired tolerances for peak production.

Instrumentation by Honeywell puts top performance into today's process control systems. Through years of experience in chemical processing problems, Honeywell specialists are qualified to engineer the kind of control your process needs, by utilizing the uniquely wide variety of recording and controlling instruments which Honeywell has developed for this field.

Your nearby Honeywell sales engineer will welcome the opportunity to discuss your specific application . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Catalog 1550, "pH and Conductivity Recorders and Controllers," and for Catalog 1531, "*ElectroniK* Controllers."

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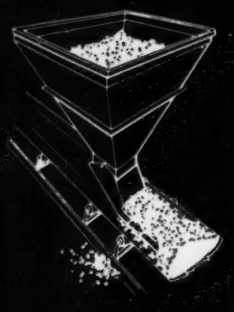
BROWN INSTRUMENTS

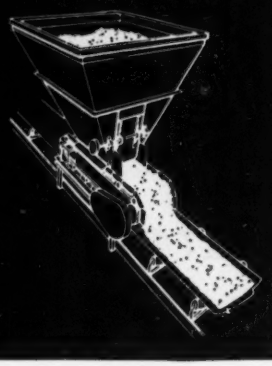
First in Controls

feed your conveyors ...to control your

not too little

not too much





but just right all the time

When your conveyors are underfed, you're stepping up costs. You're not getting the capacity you've paid for . . . subsequent operations cannot be economically controlled!

When your conveyors are overfed, you're wasting money. Subsequent plant operations are economically difficult to balance. And, the wasteful spillage causes unnecessary labor cleanup.

BUT, Rex Apron Feeders, provide the desired, metered rate for all subsequent operations. Rex Apron Feeders are the key units in the close control of plant operations.

Why not have your Chain Belt District Sales Engineer look over your plant with a view to cutting handling costs. Call him or write Chain Belt Company, 4648 W. Greenfield Avenue, Milwaukee 1, Wis.

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Typical Handling Operations Where Rex Apron Feeders Can Help Control Processing and Cut Costs

- Coal
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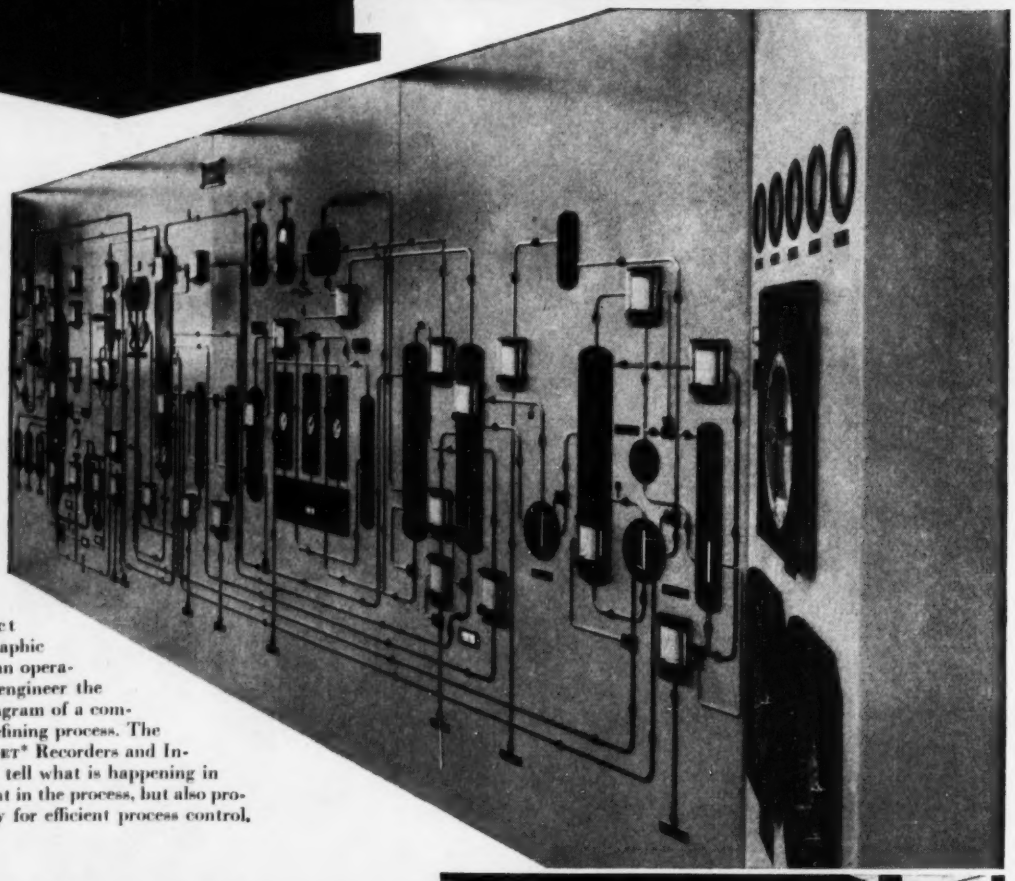


Here a compact Taylor built graphic panel reveals to an operator or a process engineer the complete flow diagram of a complex petroleum refining process. The miniature TRANSET* Recorders and Indicators not only tell what is happening in every critical point in the process, but also provide every facility for efficient process control.

ADVANTAGES OF TAYLOR MINIATURE INSTRUMENTATION

The refinements of the Taylor TRANSET* System are especially appreciated on graphic panels. Panel size is reduced, mounting is simplified, and there are fewer piping connections. Maintenance is easier, and labor and material costs are lower—*all at no premium to you!* Here are some of the outstanding advantages of the TRANSET System which make it ideal for graphic panels. They are the result of years of experience and constant refinements.

Interchangeable indicating or recording receivers.

One standard cut-out accomodates 12 different forms of recording and 11 different forms of indicating receivers.

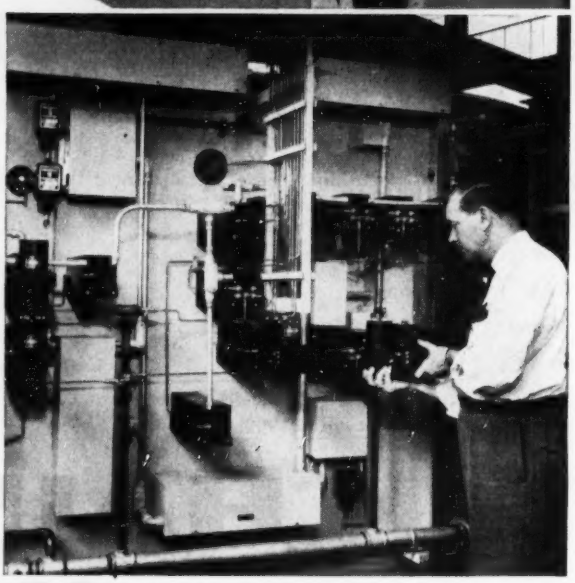
Only one mounting required for each control station, because controllers plug into backs of receivers.

No heavy space-stealing supports are required.

Only half as much space per control station—means greater accessibility and convenience.

Only three piping connections needed per station.

*Reg. U.S. Pat. Off.



Eloquent indeed is this behind-the-panel view of a section of a graphic panel. Note the economy of piping, neatness and simplicity of arrangement, and accessibility for maintenance. Plugging-in a controller is a 10-second job.

a TAYLOR PANEL ?

PANEL instrumentation, i.e., the orderly coordination of your processing instruments, pays real dividends on your instrument investment. Centralized control of a process or related processes not only enables the responsible personnel to more efficiently control production, it also gives greater protection to the instruments and accessories, and instills in operators a greater sense of responsibility and "good housekeeping."

If you have a processing problem that coordinated instrumentation may solve, whether by a conventional or graphic panel, here's why it will pay you to get it from Taylor:

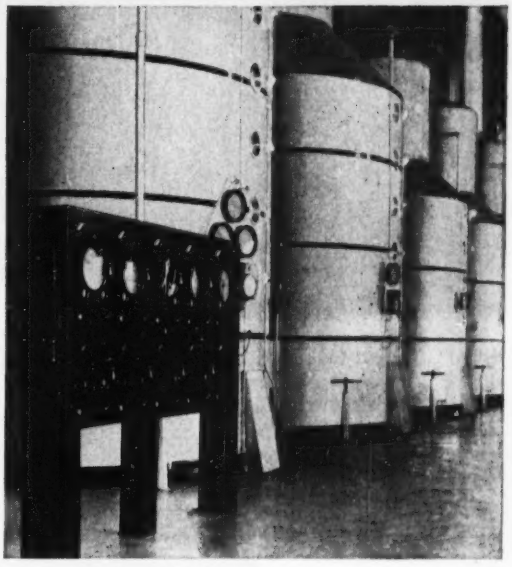
Custom made to your requirements. Taylor designs and builds panels to meet your specific needs, whether they be: **Cabinet types**—where enclosure of all units is desirable; **Open types**—where protection from dust or injury is not necessary; **Sectional panels**—which can be joined together to form future complete panels; **Graphitrol panels**—diagrammatic, graphic panels of outstanding design for completely centralized instrumentation. All are simple in design, neat in appearance, sturdily constructed and adaptable for any instrument selection.

Top quality workmanship. Our manufacturing practices are based on years of experience and a great volume and wide variety of panel production. Details are of great importance: for example, all piping is neatly arranged, sturdily mounted and adequately supported, with the minimum number of cross-overs. Wiring is laced according to best practices and meets all prevailing code requirements. Auxiliary equipment is carefully arranged so as to be easily accessible for inspection and maintenance without interfering with the function of instrumentation. Painstaking inspections are made throughout the construction of the panel.

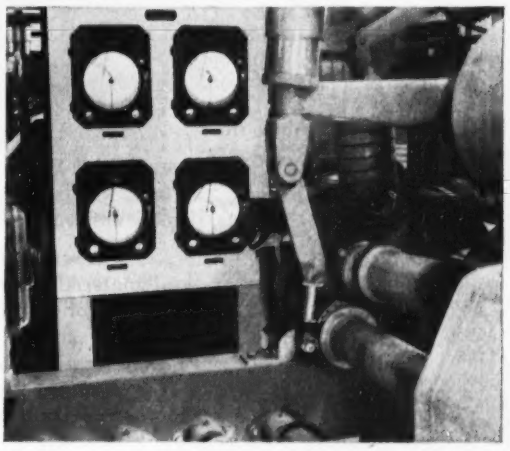
Taylor experience and know-how. Taylor engineers have a great breadth of experience in meeting specialized panel requirements in the fields of Textiles, Rubber, Chemicals, Petroleum, Paper, Food, etc. The unparalleled volume of business that Taylor has enjoyed through the years has justified the installation of special equipment and a staff of experts—not only in fabrication, but also in the ability to counsel you in the best solution for a specific problem. The head of the department is an able application engineer who has specialized in panel problems for many years.

Undivided responsibility. Taylor accepts full responsibility for doing the complete job, from helping you select the right kind of panel, through its layout, instrumentation and piping, to actually putting it in operation.

For further reasons why you should buy a Taylor panel to solve your particular problem, call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.



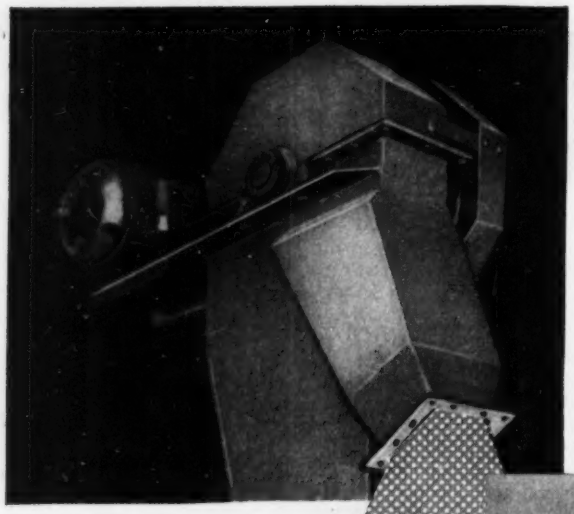
Typical of hundreds in service, this coordinated control panel relates and synchronizes all of the variables in a multiple effect evaporator in a beet sugar plant. According to the customer it gives: **1.** Maximum capacity of evaporator. **2.** Steady output of 65 Brix juice regardless of erratic beet-end operation. **3.** Substantial fuel savings. **4.** No operator required—only an occasional inspection needed.



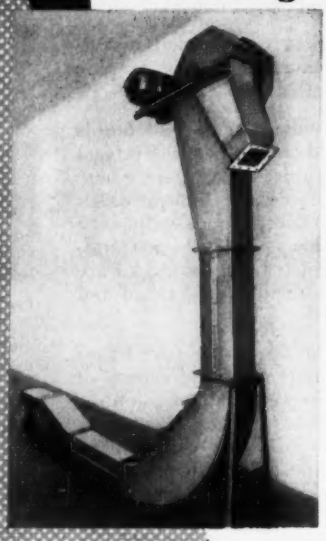
Here the simplest form of panel provides centralized convenience of related process variables, mechanical protection to the instruments and a constant reminder of "good housekeeping" to the operator. Picture shows the instrumentation for controlling both flow and temperature of mercerizing wash boxes at a well known Southern Textile Mill.

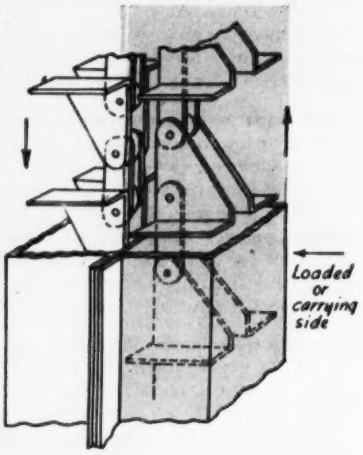
Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

Taylor Instruments MEAN ACCURACY FIRST



moving bulk material?





Section Thru Vertical Run

move it *Faster* with a
G-W FLOWMASTER

Feeding, conveying, and elevating are all taken in stride by this versatile G-W Flowmaster. It moves a variety of bulk materials in horizontal, vertical, or inclined planes—or in any combination—faster, more efficiently, and more economically. This *one* does the job of three!

A series of solid steel flights on an endless chain moves the bulk material in a continuous stream through a totally enclosed, dust-tight (or gas-tight) closely-fitted casing. The Flowmaster is self-loading and self-discharging and is designed for either continuous or intermittent operation. It's another versatile result of G-W's 139 years of progress in *engineered* materials handling . . . a policy proved by reports of increased efficiency and economy from all phases of industry.

Want to know more about the G-W Flowmaster? We'll gladly send a data sheet and full information on availability, prices, and special construction. Write today.

When you think of **ENGINEERED** *materials handling . . .*
think of **GIFFORD-WOOD**

GIFFORD-WOOD CO.

Since 1814
HUDSON, NEW YORK

420 Lexington Ave. New York 17, N. Y. | Railway Exchange Building St. Louis 1, Mo. | 565 W. Washington St. Chicago 6, Ill.

Despite cleanliness and efficiency of a midwest firm's Plastic Division, shown above, there was "dirty work" afoot in the hydraulic systems of the injection molding machines. Division superintendent (left) and A. L. Seabaugh, of Standard Oil, came up with a solution.

Stops "dirty work" in hydraulic units

● A midwest company became increasingly aware that hydraulic oil performance in its fourteen injection molding machines was not all that it should be. Formation of oil deposits not only made frequent cleaning of filters necessary but posed a threat to efficient operation of the hydraulic units.

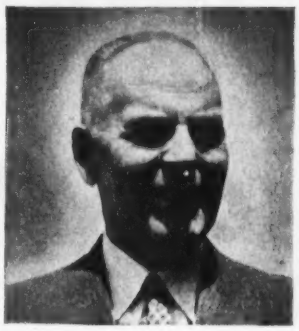
A Standard Oil lubrication specialist recommended STANOIL Industrial Oil, a top quality product of exceptionally high stability and containing necessary additives to prevent corrosion and oxidation troubles.

Throughout six years of continuous hard use, STANOIL has provided clean operation. It has not been necessary to replace any of the original fills of STANOIL, and only a small amount of make-up oil has been needed. Where filters previously had to be cleaned at least four times a year, they are now cleaned once each year. Hydraulic operation has been efficient and reliable.

STANOIL
TRADE MARK
Industrial Oil

You can rely on STANOIL to give you the same clean, dependable service not only in hydraulic units but in a wide variety of equipment. You can get the help of the Standard Oil lubrication specialist serving your section of the Midwest by phoning your local Standard Oil office. Or, write: Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

What's YOUR problem?



A. L. Seabaugh, working out of Standard's Chicago office, is the lubrication specialist who helped this midwest firm gain both operating and maintenance benefits through use of STANOIL in hydraulic units.

Located throughout the Midwest is a corps of specially trained, experienced Standard Oil lubrication specialists, ready to give you prompt, on-the-spot help with lubrication in your plant. Their broad background of practical experience, plus their thorough training in Standard Oil Lubrication Engineering Schools, is yours for the asking. Simply phone your nearest Standard Oil Company office. The lubrication specialist will call without delay. He has a complete line of petroleum products to offer, including such outstanding lubricants as:

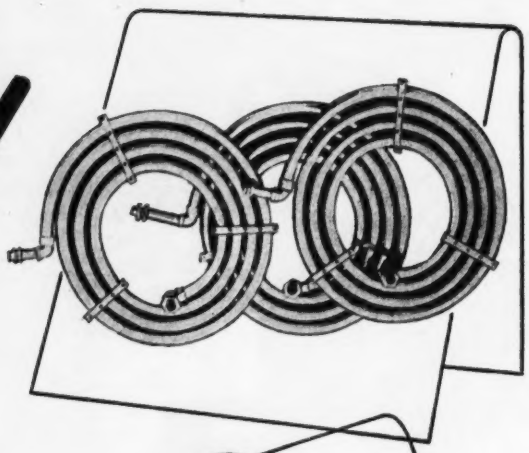
SUPERLA Greases — Available in a wide range of consistency grades and in both lime-soap and soda-soap types. SUPERLA Greases cover a wide range of operations. These efficient products are comparable in quality with the highest type of special greases.

STANOLITH Greases — Because these unique lithium soap products possess the heat resistant properties of soda-soap greases and the water resistant properties of lime-soap greases, they offer a solution to lubrication problems caused by the presence of both heat and water.

STANDARD OIL COMPANY

STANDARD (Indiana)

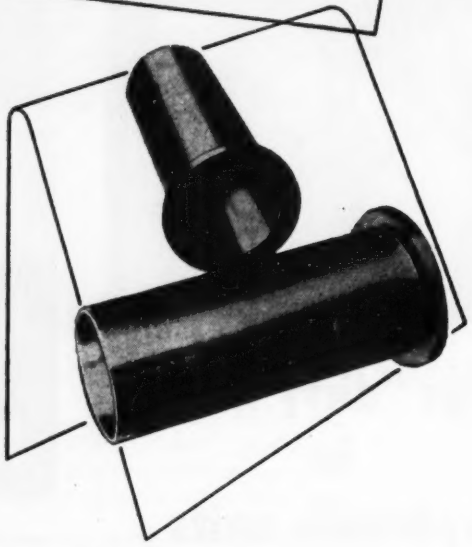
PROTECTS AGAINST CORROSION!

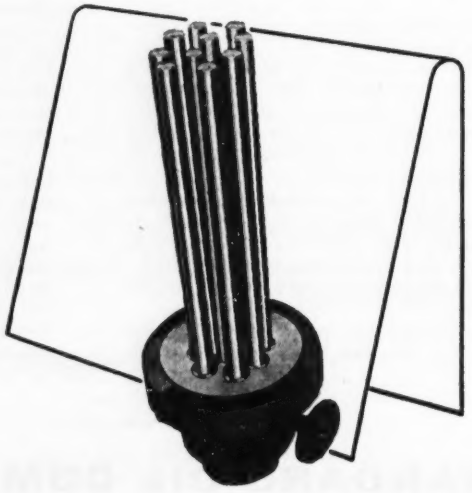


Platinum Clad...

. . . Makes the corrosion resistance of platinum available for industrial use at reasonable cost! Platinum Clad is pure platinum — or a suitable precious metal alloy — bonded throughout to a base metal support . . . It can be spun into desired shapes, drawn into seamless tubing or fabricated into shapes of interest to the chemical industry . . . The platinum thickness can be as low as .005" with assurance that the surface is free of pin holes . . . Remember — that the platinum values are recoverable so that unequalled corrosion resistance can be obtained for little more than the cost of other special alloy equipment.

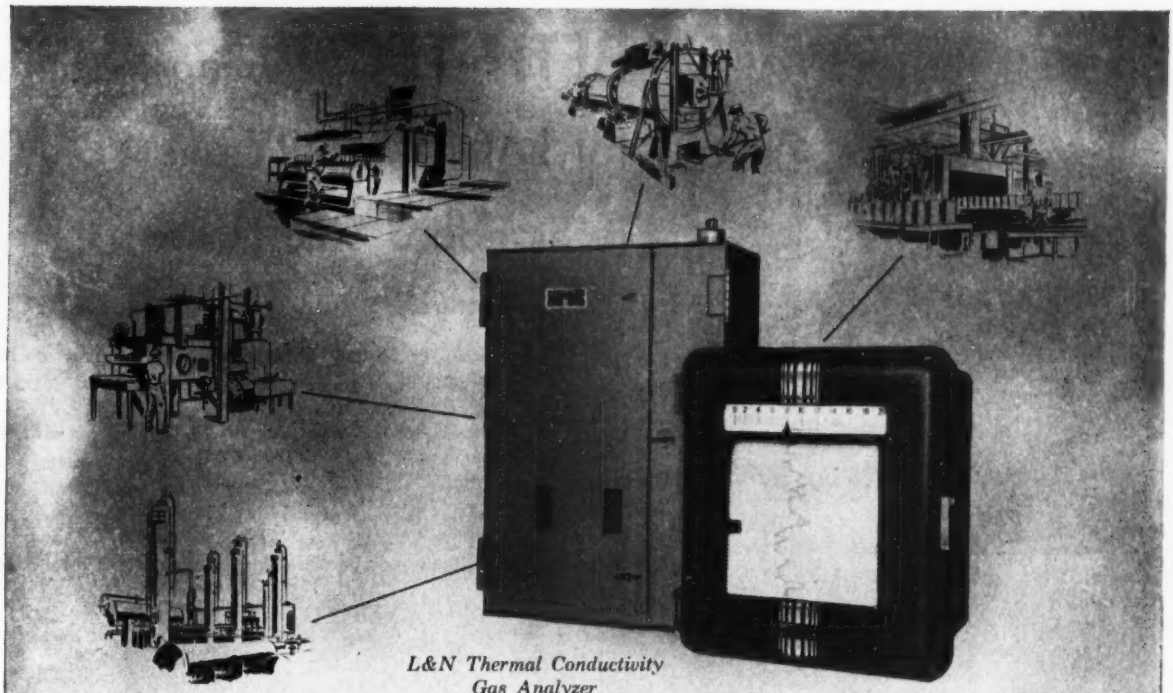
Write for Booklet 96 giving complete details.





BAKER & CO., INC.

113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • LOS ANGELES • CHICAGO



L&N Thermal Conductivity Gas Analyzer

What's your gas analysis problem?

. . . Does it deal with CO_2, SO_2, purity of H_2 and O_2? Leeds and Northrup engineers have the answers to these and many other industrial gas analysis problems in the L&N Thermal Conductivity Gas Analyzer.

Featuring the L&N Gas Analysis Cell Assembly and the advanced, electronic Speedomax® recorder, this equipment is specifically designed for exacting gas analyses. In an era of keener competition, higher taxes, and pyramiding costs, this precise recorder-analyzer will help you satisfy demands for top quality at substantial savings.

As a leader in the field, Leeds and Northrup has thirty years' experience in scientifically applying the simple, direct thermal conductivity principle to plant requirements. And prior to this, L&N pioneered in comparable equipment for laboratory research. Backed by these years of successful performance, modern L&N gas analysis instrumentation is ready to provide the highly accurate data your process needs.

CHECK THESE OUTSTANDING L&N FEATURES

Accuracy—As calibrated at the factory, this is 1.0% of range span against standard gas mixtures. You can adjust, by means of recorder dial rheostats, to any plant standard.

Sensitivity—Better than 0.5% of range span.

Stability—Readings reproducible to within 1.0% of range span.

Response—Detection, about 10 seconds. To 90% of final readings, 50 seconds.

Cells—All-glass construction prevents corrosion and consequent loss of calibration. All cells for a given gas and range of concentration are interchangeable. Cell assembly has no moving parts; requires no reagents for analysis.

Cell Housing—Assures constant temperature for cells because insulated and thermostatically controlled at 130 F.

Measuring Circuit—Powered by standard a-c source, through converter to accurate d-c Wheatstone bridge. This bridge minimizes "pick-up" often found in low level a-c measurements. Two ordinary copper wires connect recorder and analyzer.

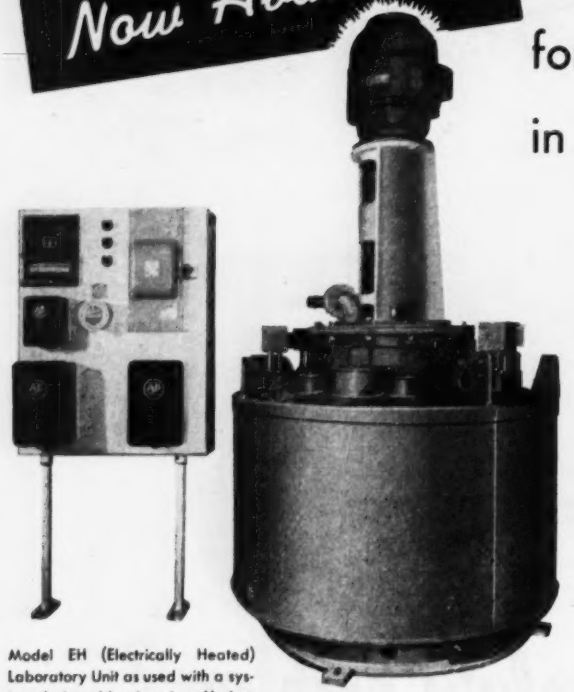
For Folder ND46-91(2), "Speedomax Gas Analysis Equipment," write to Leeds & Northrup Co., 4916 Stenton Ave., Philadelphia 44, Pa., or contact your nearest L&N field office.

LEEDS NORTHRUP
instruments automatic controls • furnaces

Jrl. Ad ND46-91(5)

Now Available

BETH-TEC Heating Systems for LABORATORY and PLANT in Standard Size Units.

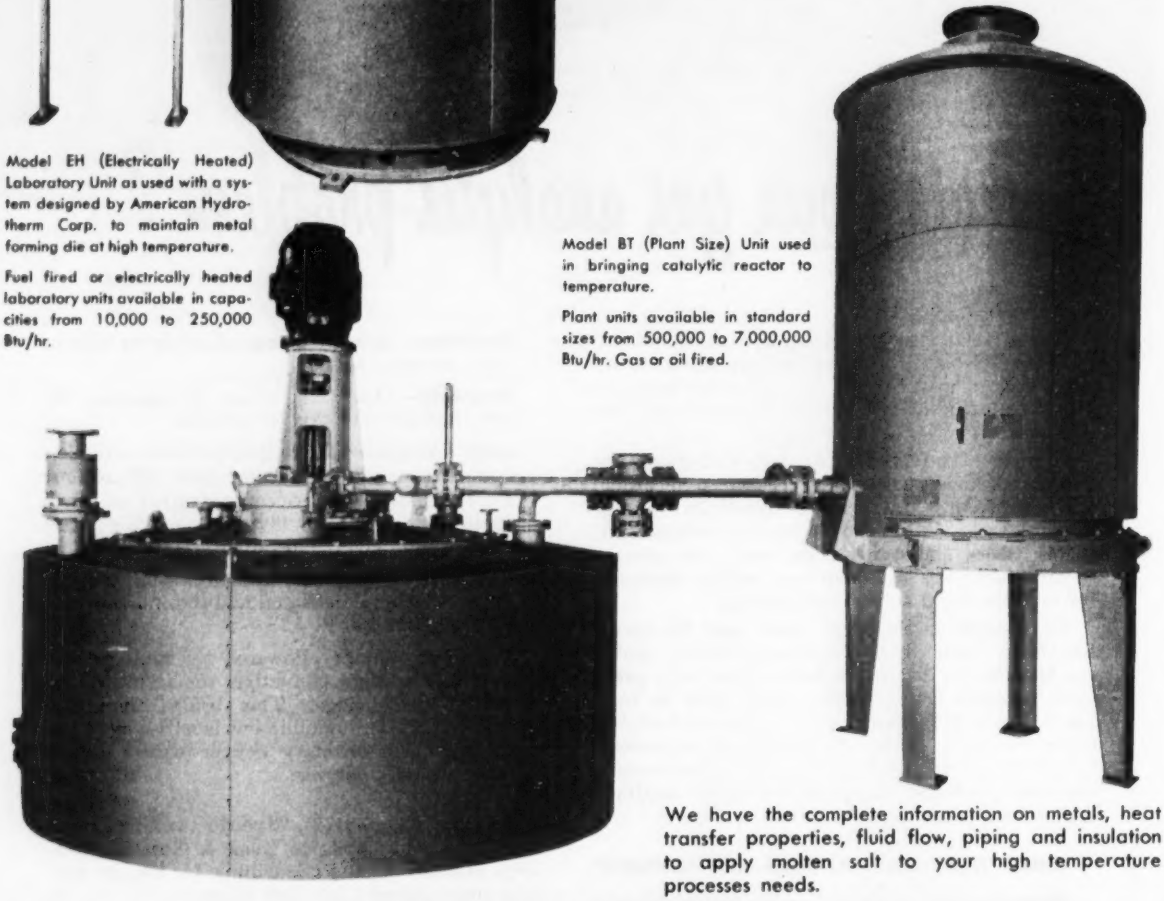


Model EH (Electrically Heated) Laboratory Unit as used with a system designed by American Hydrotherm Corp. to maintain metal forming die at high temperature.

Fuel fired or electrically heated laboratory units available in capacities from 10,000 to 250,000 Btu/hr.

Features:

- Beth-Tec Systems provide for liquid heating and/or cooling at no pressure in range from 700° to 1000°F.
- Heat transfer salt (duPont 'Hi-Tec') is an efficient thermal medium. It is non-toxic, non-corrosive, non-fouling, chemically stable and inexpensive.
- Complete systems furnished; shipped in complete sections to facilitate inexpensive and rapid installation.



Model BT (Plant Size) Unit used in bringing catalytic reactor to temperature.

Plant units available in standard sizes from 500,000 to 7,000,000 Btu/hr. Gas or oil fired.

We have the complete information on metals, heat transfer properties, fluid flow, piping and insulation to apply molten salt to your high temperature processes needs.

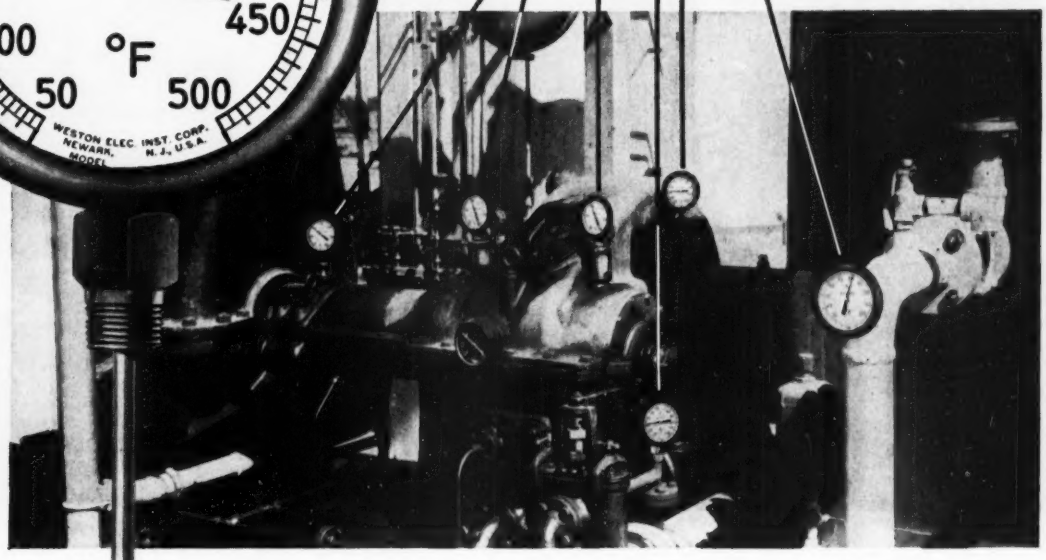
For full details regarding Beth-Tec units, write

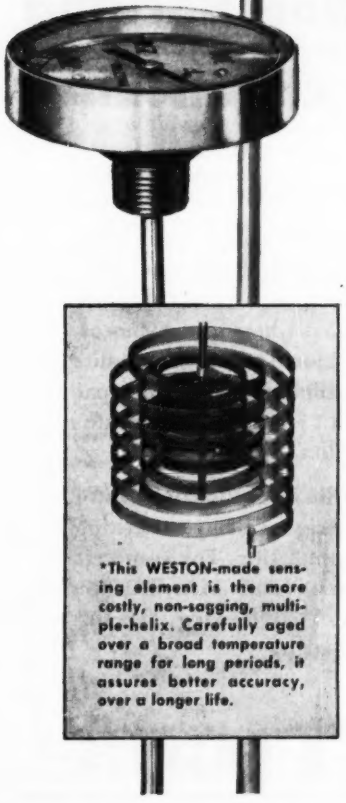
BETHLEHEM FOUNDRY & MACHINE CO.

PROCESS EQUIPMENT DIVISION

BETHLEHEM PENNSYLVANIA

AT EVERY CHECKPOINT





*This WESTON-made sensing element is the more costly, non-sagging, multiple-helix. Carefully aged over a broad temperature range for long periods, it assures better accuracy, over a longer life.

WESTON *all-metal* THERMOMETERS

(with Multiple Helix)*

Here's another typical example of how large processing plants have solved temperature checking problems, and cut thermometer costs besides. With a WESTON dial-type thermometer at every checkpoint, temperatures are read at a glance . . . in far less time, and with far greater accuracy. Their sturdy all-metal construction resists breakage, gives them far longer life on operating equipment. And the exclusive WESTON multiple helix employed assures dependable accuracy during all this long life.

Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON 5537 *Thermometers*

Stocked by leading Distributors

background photo courtesy of Shell Oil Company

J-M CHEMPAC®—an asbestos-Teflon packing that withstands virtually ALL chemicals

THIS NEW Johns-Manville development combines the sealing action and heat-resistant characteristics of asbestos with the all-around chemical resistance of Teflon. Its base is strong, resilient asbestos fibers thoroughly impregnated with chemically inert Teflon.

The versatility of Chempac greatly reduces the number of packing styles needed for chemical equipment. Stocking presents no problem because its inert ingredients do not deteriorate.

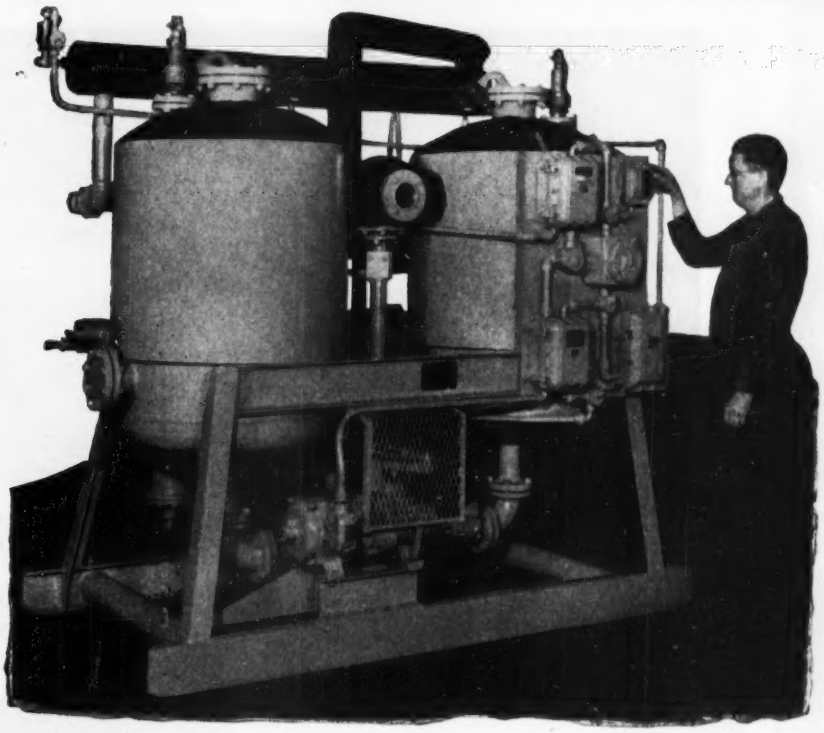
Chempac can be recommended for packing pump rods or shafts, valve stems, agitator shafts, expansion joints, rotary filters and similar apparatus. It is outstanding in service against many acids, alkalies, caustic solutions, and solvents, at temperatures to 525° F.

Chempac Packing is available in coil, spiral and ring form for rod, plunger and valve stem service. Style Nos. 2011, 2012 and 2013 are made of white Canadian Chrysotile Asbestos. No. 2014 is made of blue African Crocidolite Asbestos. Johns-Manville also makes Chempac Gaskets, Nos. 117 and 138 of plies of asbestos cloth treated with Teflon.

Your Johns-Manville Packing Distributor can help you select the right Chempac Packing or Gasket for your application. For complete information write him or Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS



Fully automatic instrument air dryer . . . BY-type Lectrodryer

DRY AIR and how to get it...

Even on the most arid desert, air is wet! Elsewhere, it's wetter. Hence, if you need dry air, you must use machinery to get it.

A Lectrodryer* is an air drying machine. With it you can dry great volumes of air in a continuous flow to prescribed low dewpoints. You can reduce the moisture content of air to a stable constant!

Lectrodryer machines can drop air to dewpoints below −100°F . . . reduce relative humidity below 10%.

There's probably a Lectrodryer already built that meets your drying need. The largest (for a wind tunnel) dries three tons of air per minute to a dewpoint of −70° F. Smaller machines are preserving the interior of Navy ships of the "Mothball Fleet" by maintaining a constant relative humidity below 30%.

Besides air drying, there are Lectrodryers that dry many gases and organic liquids, handling pressures as high as 6000 psi.

If you use air, give some thought to drying it with a Lectrodryer. Write for *Because Moisture Isn't Pink,* a booklet describing Lectrodryers and how industries have used them. Request also, *The Moisture In Our Atmosphere,* a technical booklet on the nature, behavior and measurement of water vapor. Both are free! Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pa.

LABORATORY LECTRODRYER

If your experimentation requires small quantities of dry air or other gases, a Laboratory Lectrodryer will help you greatly. Rated at 100 cubic feet per hour, these machines have in many cases provided the dryness in research that has led to large savings in production.

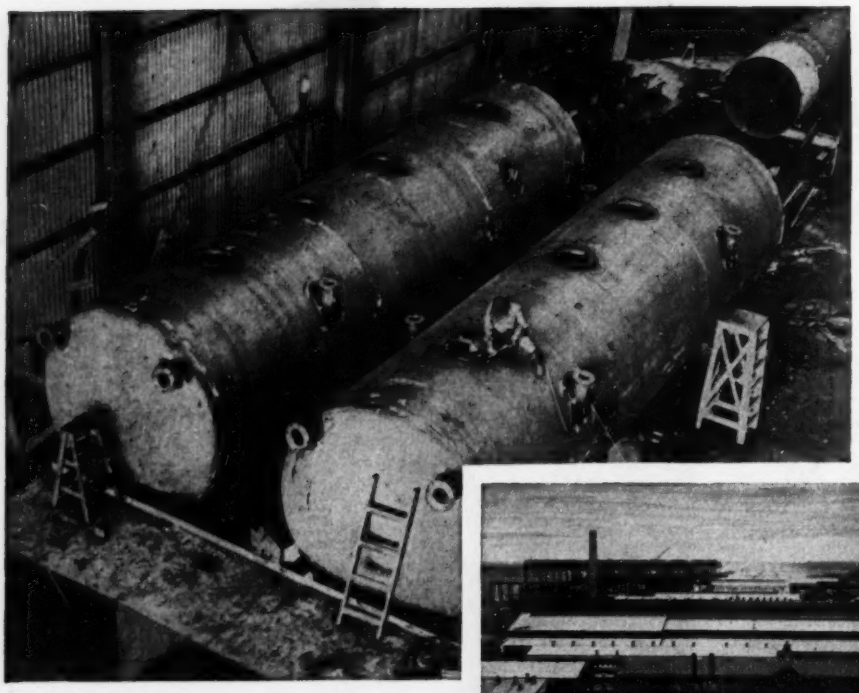
$155.00 F. O. B. Pittsburgh

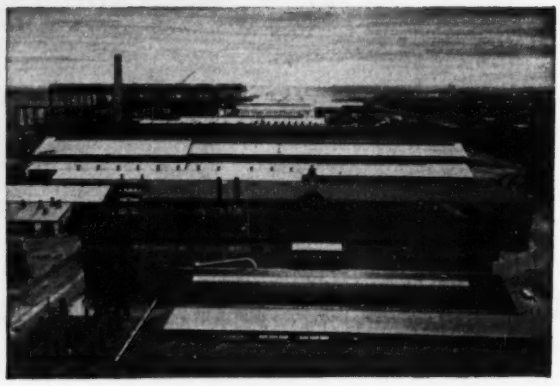
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.





A Mile of Shops – Each shop is devoted to a special type of heavy production. Included are complete Machine Shops, casting, forging and other facilities which offer all of the advantages of the execution of the complete job.

A half mile of pressure vessels

These are two of seventy – over ½ mile – of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known chemical maker.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in *Facilities and Products*. As you glance at its photos and brief captions, you'll see why Newport News can turn out – at low cost – specialized heavy equipment for chemical plants.

Send for *Facilities and Products* – free – today.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

DESIGN and PRODUCTION NEWS

FOR PLASTICS AND MATERIALS ENGINEERS

Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company APRIL-MAY 1954

Kel-F® Keeps Jet's Fuming Nitric Acid Line Secure Under Severe Minus 65 to +165°F Cycling

Fuming nitric acid vapor, operational shock and thermal cycling can't loosen the grip of these special lock nuts fitted with inserts of "Kel-F" plastic.

Viciously corrosive fuming nitric acid cannot attack chemically-inert "Kel-F". Once tightened, nuts remain tight, in spite of sub-zero to 165°F variations of temperature, because of the dimensional stability of the plastic inserts. Engine vibrations or accidental blows won't crack or weaken the "Kel-F" which has exceptional impact and compressive strength. Exposure to moisture doesn't affect the plastic's form or properties . . . preventing failure from swelling, shrinkage or softening.

The Elastic Stop Nut Corporation of America, Union, N. J., produces these fasteners using corrosion-resistant alloys with inserts injection-molded from "Kel-F" polymer Grade 300 (unplasticized). Elastic Stop* nuts with "Kel-F" are produced in sizes from #10 to 3/8", with jet and rocket manufacturers listed as major users.

For further information ask for Application Report C-114

*Trade-Mark Elastic Stop Nut Corporation of America

Magnetic Stirring Bars Sealed in Kel-F® to Stop Corrosion and Breakage

A vacuum-tested casing of "Kel-F" permits these metal bars to be used indefinitely to "mix" highly corrosive acids, alkalis, solvents and peroxides—at from minus 200°C to plus 200°C—without corrosion or breakage. The fluorocarbon "skin" cannot crack or chip. Non-porous and non-absorbent, the covering is virtually self-cleaning, can even be sterilized.

Three sizes of stirring bars are now made by the Arthur H. Thomas Company of Philadelphia, Pa., by sealing cylindrical permanent magnets into extruded tubing. Extruded from unplasticized "Kel-F" Grade 300 by the Plax Corporation of Hartford, Conn.

For further information ask for Application Report C-115

® *Registered trademark for The M. W. Kellogg Company's trifluorochloroethylene polymer products*

(SEE REVERSE SIDE)

CONTINUED FROM PRECEDING PAGE

Saunders Valve Diaphragm of Kel-F® Controls Aromatics, Ketones at 230°F ...Cuts Maintenance Costs

Greatly increased diaphragm life and a sharp reduction in valve maintenance resulted when Grinnell-Saunders valves handling active organics were equipped with diaphragms of plasticized "Kel-F". Diaphragms have remained flexible, "sticking" has been eliminated and positive fluid control maintained.

"Kel-F" was specified because of its known inertness to practically *all* chemicals, even at elevated temperatures. The diaphragm retains its flexibility, being plasticized with chemically resistant "Kel-F" polymer oils.

Valve diaphragms, with imbedded metal studs, are compression molded from Grade 300 P-25 (25% plasticized) "Kel-F" polymer by the Chicago Die Mold Division, United States Rubber Company, Chicago, Ill. Diaphragms of "Kel-F" are used in thickness from .040" to .090" by the Grinnell Company, Providence, R. I., in Saunders-Type valves of ½" to 8" capacity.

For further information ask for Application Report C-116

Molders & Fabricators of the Month

Leading molders, extruders and fabricators specialize in the production of materials and parts made of "Kel-F"... each month this column will spotlight several of these companies with their principal services and products.

Brilhart Plastics Corporation
Mineola, N. Y.
Injection, Compression & Transfer Molding
Electrical & Electronic Components
Gaskets, Diaphragms & "O" Rings

Fluoro Plastics, Incorporated
Philadelphia, Pa.
Compression & Transfer Molding
Gaskets & "O" Rings; Valve Seats; Containers
Electrical & Electronic Components

The Garrison Company
Kenilworth, N. J.
Extrusion & Production Machining
Electrical & Electronic Components
Wire Insulation

Penn-Plastics Manufacturing Co.
Glenside, Pa.
Compression & Transfer Molding
Electrical & Electronic Components

Porous Plastic Filter Company
Glen Cove, N. Y.
Porous Filters

Recent Significant Developments in "Kel-F"

Electronic Tube Caps boost performance of high-altitude communications equipment, removing interference from thermal cycling, high humidity.

Asbestos, Glass Fiber, other fillers being successfully incorporated in molded parts in high temperature, corrosive valve service, structural electrical members.

Float Bodies of "Kel-F" and powdered metal incorporated in flowmeter bodies machined of "Kel-F" for smaller, more accurate measuring devices for severe corrosives, liquid or gaseous.

Welding, by "hot gas" method being used in fabrication of corrosion-resistant feed hoppers.

Visit the Kel-F **POLYMER EXHIBIT** *at the Basic Materials Show May 17-20--Chicago, Ill.*

For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write
Technical Service
CHEMICAL MANUFACTURING DIVISION
THE
M. W. KELLOGG
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P. O. Box 469, Jersey City 3, N. J.
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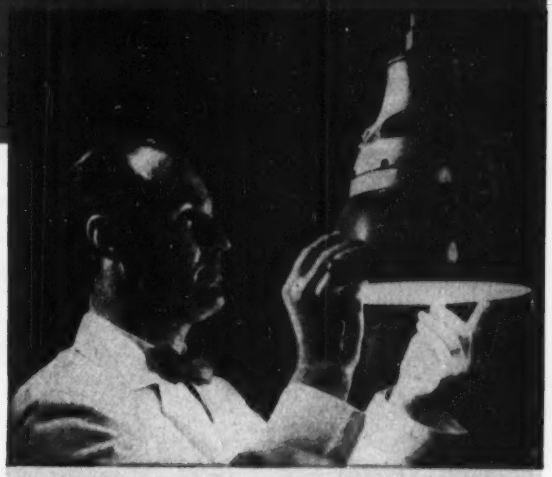
KELLOGG PULLMAN

® Registered trademark for The M. W. Kellogg Company's trifluorochloroethylene polymer products.

Rigid testing of *Explosion-Proof* CONDULETS*

assures safety and long dependable service



Probing for maximum exterior operating temperature on a Type EVA Explosion-Proof Lighting Fixture using a multiple point recording potentiometer.

Crouse-Hinds extensive laboratories and modern manufacturing combine to give you top quality

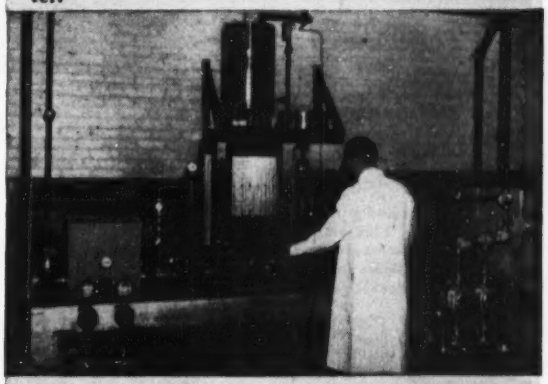
Laboratory testing is one of the key operations in the production of electrical equipment of the highest quality. Crouse-Hinds laboratories are equipped with the latest scientific instruments and staffed with expert technicians.

Products are constantly tested to make sure that they are being made to withstand field conditions. New devices are tested to predetermine their meeting or surpassing the requirements of Underwriters' Laboratories.

The photographs at the right show three of the many testing operations that are done in the Electrical Laboratory. It is equipped with apparatus for making both alternating and direct current tests, heat tests, pressure tests and many others.

Close cooperation between Crouse-Hinds laboratories and manufacturing departments is one of the reasons why Condulets have been the "Standard of Quality" for nearly fifty years.

Specify CONDULETS on every job. They're made right... to serve you better... and last longer.



Adjusting carburetors and flow meters to create a predetermined explosive mixture within an explosion-proof Condulet for an explosion test.

When quality counts
... you can count on Condulets

Photographing the pressure wave in the Oscilloscope to determine the maximum explosion pressure within an explosion-proof Condulet that is behind the concrete wall.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

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CONDULET
First in the field
STANDARD OF QUALITY

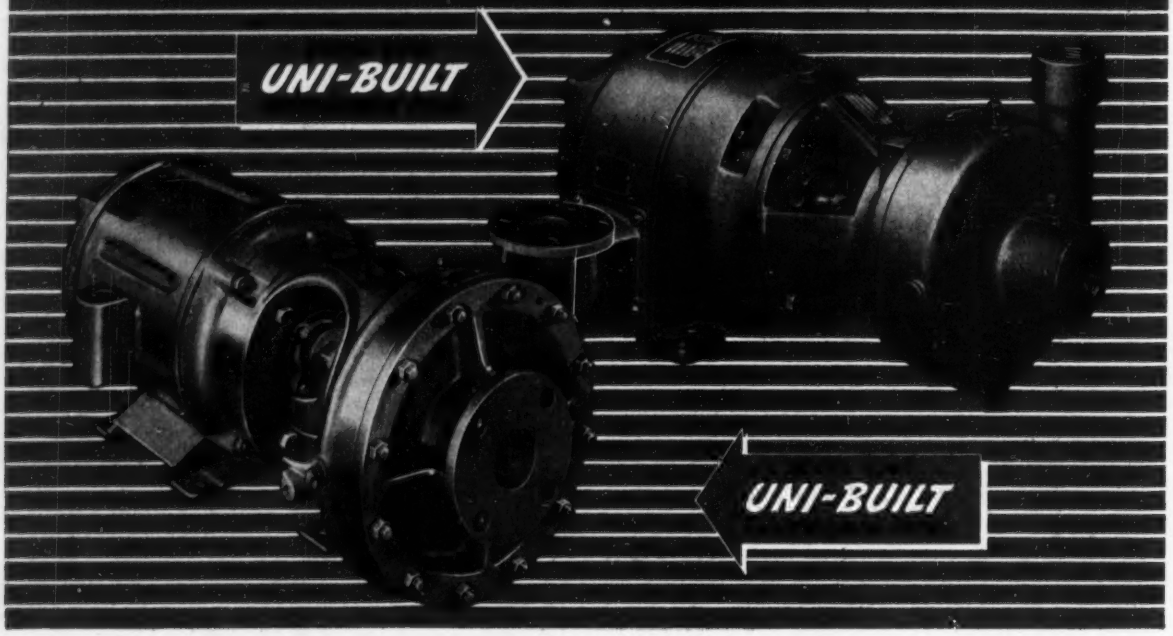
*CONDULETS are made only by CROUSE-HINDS

A Nationwide Distribution Through Electrical Distributors

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

NO WAITING . . .

Popular sizes carried in stock!



Sizes, capacities and prices on B & G Series 1522 and 1531 Stock Pumps are given in a bulletin available upon request. Send today for your copy.

B & G manufactures a comprehensive line of Hydro-Flo Centrifugal Pumps and Heat Exchangers for industrial applications. Send for catalogs.

These are *the* pumps which stand up under hard service in industrial plant applications! For your convenience, a stock of most commonly used sizes is maintained at the factory—ready for immediate shipment.

The leak-proof "Remite" Mechanical Seal alone makes these pumps a *buy!* This new-type Seal is harder than glass—wear-proof, corrosion-resistant. It's self-lubricating and eliminates the usual leakage through the packing gland—assures trouble-free operation.

Smooth running . . . quiet!

Oversize bearings hold the shaft in alignment for smooth, quiet performance...balancing of the impeller prevents shaft vibration and seal failure. All parts are machined to rigid specifications, carefully inspected and assembled—assurance of minimum installation and maintenance expense. B & G Series 1522 and 1531 Pumps kept in stock at the factory are bronze-fitted only, but are available as all-iron, all-bronze or stainless steel units.

With all these advantages, you'll find them competitively priced!

BELL & GOSSETT
COMPANY
Dept. DJ-14, Morton Grove, Ill.
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto, Canada

7 Typical Emulsions and Dispersions *Improved by* Gaulin Homogenizers

LATEX THREAD — makes it smoother, more uniform . . . improves dip and extrusion characteristics.

LIQUID STARCH — Stops separation. Improves transparency and clarity.

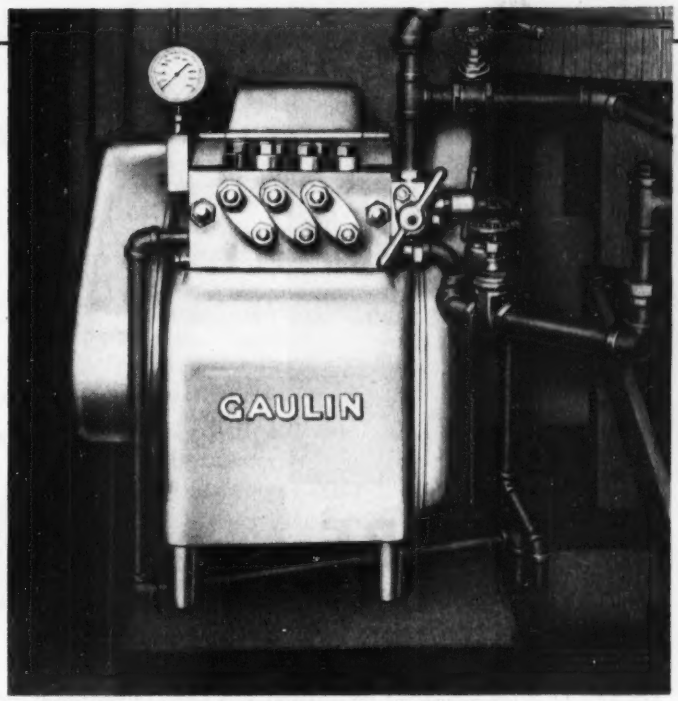
PIGMENT DISPERSION — gives a finer, more uniform suspension with less temperature rise.

LUBRICATING OIL — improves lubricating value and stability. Increases service life.

CREAM OIL — Looks less greasy, feels less greasy . . . spreads quicker, holds better.

COSMETIC EMULSION — Has a smoother texture, longer shelf-life. Perfume is locked-in against evaporation.

WAXES — for uniform, stable emulsions and viscosity control.



Warwick Division of Sun Chemical Co. uses this 500 GPH Gaulin to process its water repellent mixtures into uniform, stable emulsions.

And there are many more, each with its own set of reasons for using Gaulin Homogenizers. But there's one they *all* agree on — Gaulin Homogenizers are a FASTER, MORE ECONOMICAL way to make uniform and stable emulsions or dispersions.

Why not investigate today. Complete testing facilities and engineering advice are yours without obligation.

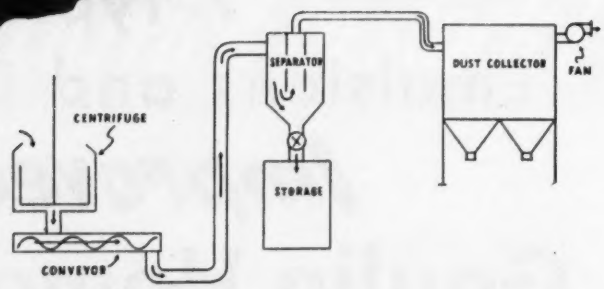
GAULIN PILOT PLANT HOMOGENIZER
Ideal for experimental purposes, operation or process requiring up to 25 gallons per hour capacity. Handles quantities as small as one pint. Available on low rental basis.

GAULIN TWO-STAGE COLLOID MILL
Stator is jacketed for cooling or heating. Gap setting adjustable for .001" to .045". Only 45 seconds clean-up required in changing colors. 12" head room. 12" x 17" floor area.

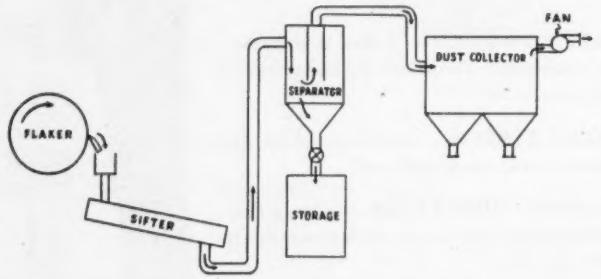
Manton-Gaulin
MANUFACTURING COMPANY, INC.
71 GARDEN STREET, EVERETT 49, MASS.
World's largest manufacturer of Homogenizers, Triplex Stainless-Steel High Pressure Pumps, and Colloid Mills

A MIDWEST CHEMICAL CO.

saves $112,500 annually salvages 600,000 lbs. of chemicals with

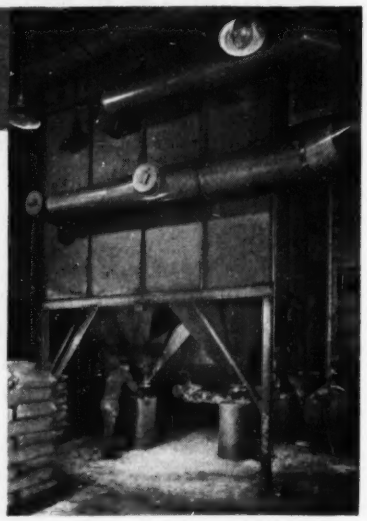


Two complete Dustube Dust Control systems are used to eliminate dust nuisances in this midwest chemical plant. In one system about 25,000 lbs. of very fine material is handled daily. From 5% to 7% of this dust escapes preliminary separators and is trapped in a Dustube Collector. As this dust is worth 15c a pound, a minimum of $187.50 is saved each day.



In the second system which ventilates chemical processing stations, a minimum of 750 pounds of valuable material is recovered each day with a Dustube. At 25c per pound, the product recovered daily has a value of $187.50.

DUSTUBE dust control



The two Dustube Collectors installed at this chemical company have paid for themselves many times over with their thorough dust removal. As explained above, these collectors are saving $375.00 daily in product recovery alone.

In addition, the Dustube Collectors' highly effective filtering action traps even the finest dust with virtually 100% efficiency to keep the plant completely dust free. Their simple, practical design provides the highest efficiency at an unusually low operating cost.

Let Dustube engineers show you why users everywhere say: "It pays to own a Dustube."

Send for this 28-page Dustube brochure showing typical applications in 18 major industries.

American
WHEELABRATOR & EQUIPMENT CORP.
347 S. Byrkit St., Mishawaka Ind.

dustube COLLECTORS

STURTEVANT

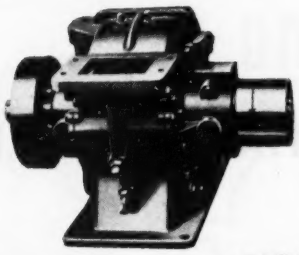
Laboratory Equipment...

assures accurate samples... cuts laboratory sampling costs

Sturtevant laboratory equipment have all the features of full-sized production machines with extra accuracy and wider range of adjustment built-in. They are fast... provide true samples of every batch processed.

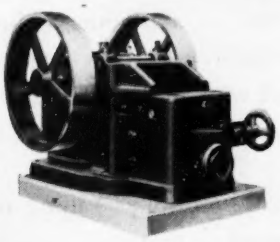
All Sturtevant machines have "open-door" accessibility which permits quick, thorough cleaning... prevents the possibility of previous batches from contaminating new samples. Their rugged construction assures round the clock operation with practically no maintenance.

Investigate Sturtevant equipment for your laboratories. They will help you cut sampling costs... improve product quality... increase sales. Write for catalog, today.



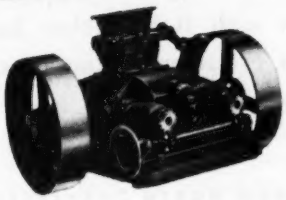
LABORATORY SWING-SLEDGE MILLS

Capable of reducing soft, moderately hard and tough or fibrous materials to any degree of fineness between 1 in. and 20 mesh. The patented "Open-Door" feature permits ready accessibility for cleaning.



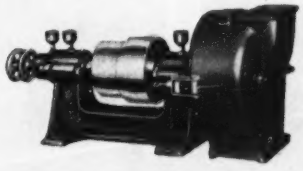
LABORATORY JAW CRUSHERS

Special Roll Jaw action simplifies close regulation of the product with capacities varying from 300 to 400 lbs. per hour at finest settings, to 1000 or 2000 lbs. when opened for coarser work. Each part of the crusher is accessible for quick and easy cleaning.



LABORATORY CRUSHING ROLLS

First designed especially for laboratory sampling work, Sturtevant Crushing Rolls are used regularly in many plants where there are limited out-puts. Range of output for the 8 x 5 size is from ½ in. to 20 mesh — and for the 12 x 12 size from ¾ in. to 20 mesh.



LABORATORY SAMPLE GRINDER

Laboratory Sample Grinders are of the "Open-Door" disc type and are capable of very fine work, producing products as fine as 100 mesh (coarser if desired) when working on dry, friable, soft or moderately hard materials. Simply turn hand wheel to provide product regulation from 10 to 100 mesh.

STURTEVANT MILL COMPANY

100 Clayton Street, Boston 22, Mass.

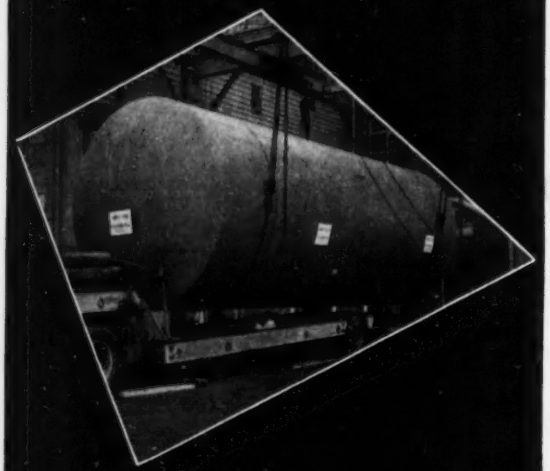
Designers and Manufacturers of

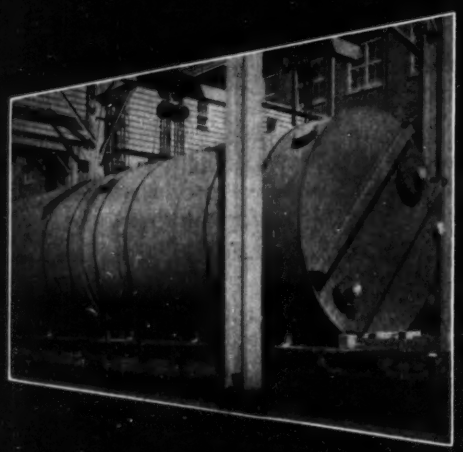
CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS • MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

PROTECT EQUIPMENT and PROCESSES

with

MANHATTAN RUBBER LININGS





Permanent, positive protection against loss from tank corrosion and contamination . . . That's what you get with Manhattan Rubber Linings.

They are made from thick, calendered sheets of natural or synthetic rubber for utmost durability . . . they expand and contract with the metal under temperature changes . . . resist abrasion and cracking.

Every Manhattan Rubber Lining is inseparably bonded to metal . . . every Manhattan Lined tank is tested dielectrically under 15,000 volts, to assure flawless protection.

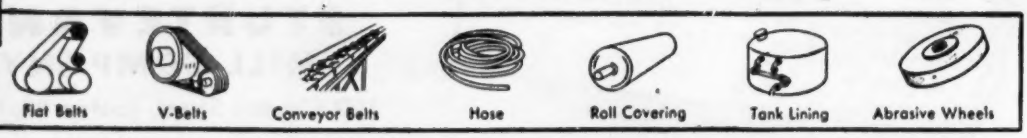
Let a Manhattan lining engineer help you with your tank corrosion problems . . . and show you how you also get lasting protection with R/M rubber lined pipe, fittings, extractors, evaporators, etc., for the chemical industry.

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.

RM

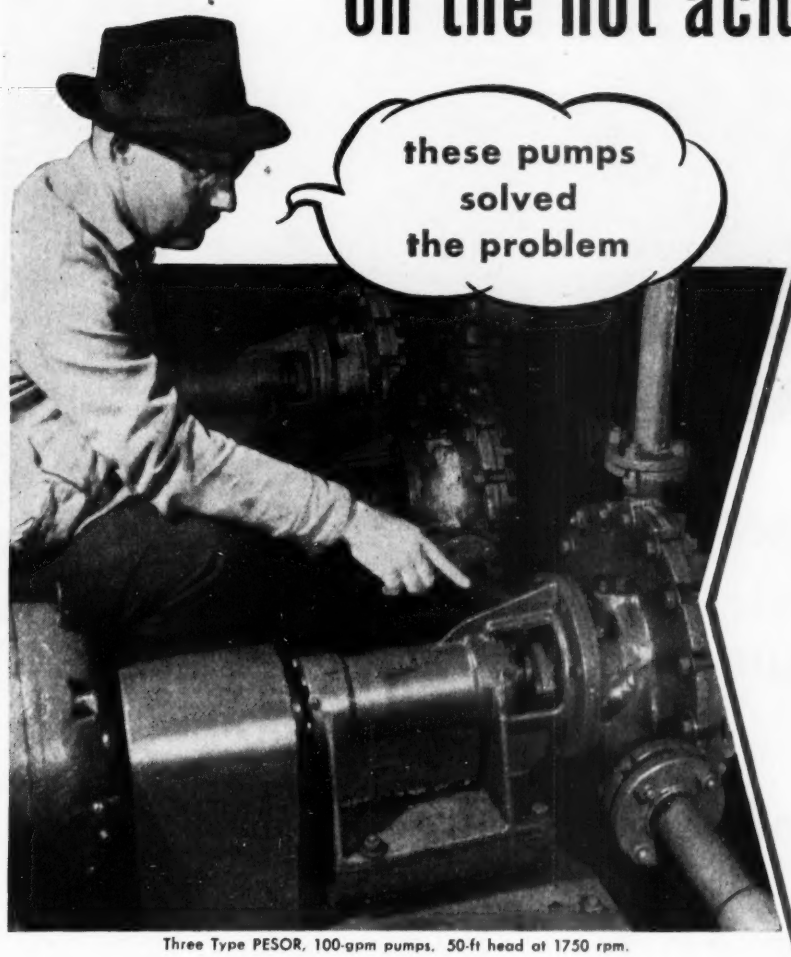
MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls. RM-422

No More Leakage
on the hot acid line...



Three Type PESOR, 100-gpm pumps, 50-ft head at 1750 rpm.

Why this A-C pump does not leak

These process pumps have *Equiseal* stuffing box. This is an auxiliary impeller which produces a low pressure area in front of the packing. This low pressure area prevents the liquid from entering the packing. Equipped with an *Equiseal* stuffing box, an A-C pump will actually run without packing and not leak. Pumps also are available with standard stuffing box or mechanical seal. Each application is individually engineered.

Allis-Chalmers process pumps are available in a wide choice of materials to handle many types of abrasive or corrosive material at temperatures up to 250 F.

Tennessee Products and Chemical Corp., Chattanooga, Tenn., solved a tough pumping problem with Allis-Chalmers process pumps. Previous pumps used for sulphate recovery leaked badly. They were a constant source of packing and mechanical seal trouble. In addition, the leaking chemical shortened the life of the surrounding equipment. Production of the entire recovery system depends on these pumps. Every stop lowers production...boosts costs.

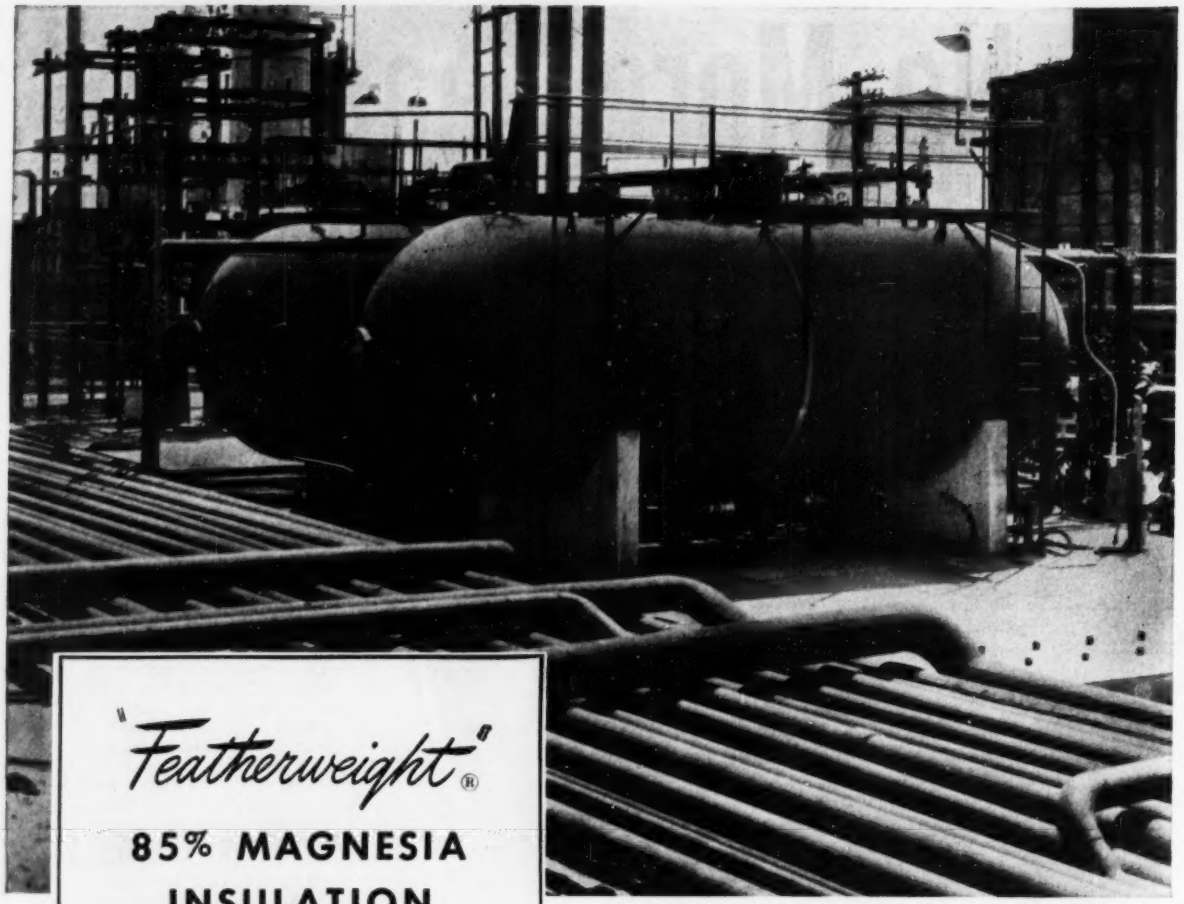
Then Allis-Chalmers process pumps were installed. They pump hot acid with ammonium sulphate (sand sized particles) 24 hours a day, 7 days a week. There is no leakage... packing and seal trouble is gone... maintenance costs are cut sharply.

For full information on Allis-Chalmers pumps and how they can help you with your pumping problems, call your local A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 08B6615.

A-4230

Equiseal is an Allis-Chalmers trademark.

ALLIS-CHALMERS



"Featherweight"®

85% MAGNESIA INSULATION

Desalters and piping in West Texas Refinery, insulated with "Featherweight" 85% Magnesia and covered with weatherproofing materials. Insulation contractor: Willard A. Selle Co., Inc., El Paso, Tex.

helps refinery conserve dollars

"Save heat—save money" is an operating rule that holds true for almost every industry. In the refinery illustrated here, heat is effectively conserved by the use of "Featherweight" 85% Magnesia, used to insulate various pieces of hot piping and equipment.

For any industrial insulation use, "Featherweight" proves to be a thrifty choice. By itself this material (85% basic carbonate of magnesia and asbestos fiber) has an effective insulating range up to 600°F. Used with K&M Hy-Temp Insulation, its range is extended to 1900°F.

Hy-Temp is applied directly to the hot surface, and "Featherweight" is used as the second layer. The two materials, when applied with staggered vertical and horizontal joints, eliminate heat loss which occurs on single layer installations when the expansion of hot piping and equipment causes joints to open.

These K&M insulations will last the life of the equipment they serve, will withstand moisture, vibration, and frequent temperature change. With a waterproof jacket, they serve equally well outdoors. Both materials are supplied in various sizes and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

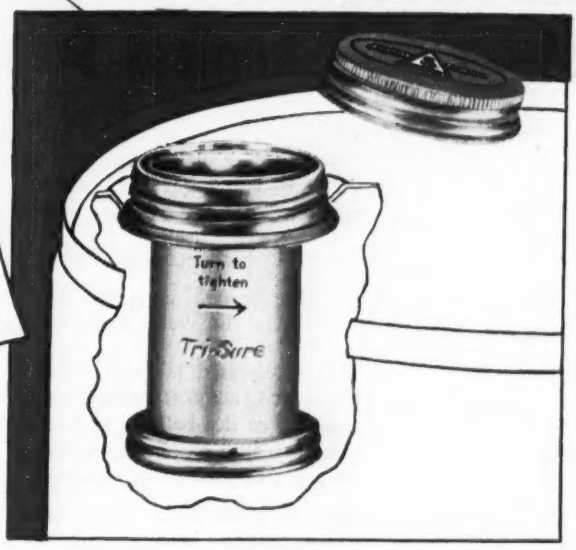
Nature made asbestos... Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos

Here's the pail that customers like!

RIGID SPOUT *gives secure control of pouring*

SPOUT RETRACTS *for easy filling and shipping*



The Tri-Sure* 2¼" Threaded Spout gives your pails a definite sales value by providing a strong rigid spout for pouring. This Tri-Sure spout retracts for fast filling through large opening.

The Tri-Sure nozzle for this spout receives a tamper-proof seal and is threaded for the Tri-Sure screw cap. These screw caps can be furnished lithographed.

Modernize your containers with the closure that makes your filling easier, builds good will —and business. On your next pail order, specify the Tri-Sure Threaded Spout.

**The "Tri-Sure" Trademark is a mark of reliability backed by over 30 years serving industry.*

Tri-Sure
Reg. U. S. Pat. Off.

FOR DRUMS The Tri-Sure Flange, Plug and Seal

CLOSURES

FOR PAILS & CANS Nozzles, Spouts, Seals and Caps

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Tri-Sure Products Limited, St. Catharines, Ontario, Canada

Lab test shows *corrosion-resistance* of Welded Stainless Steel Tubing

That's a piece of ELECTRUNITE Stainless Steel Tubing on the left. On the right you see it after boiling in a 20 per cent hydrochloric acid solution. And this is what happened:

Wall thickness was reduced from .089 inches to .059 inches.

But the weld area was only reduced to .068 inches. In other words, the weld wasn't subject to preferential corrosion.

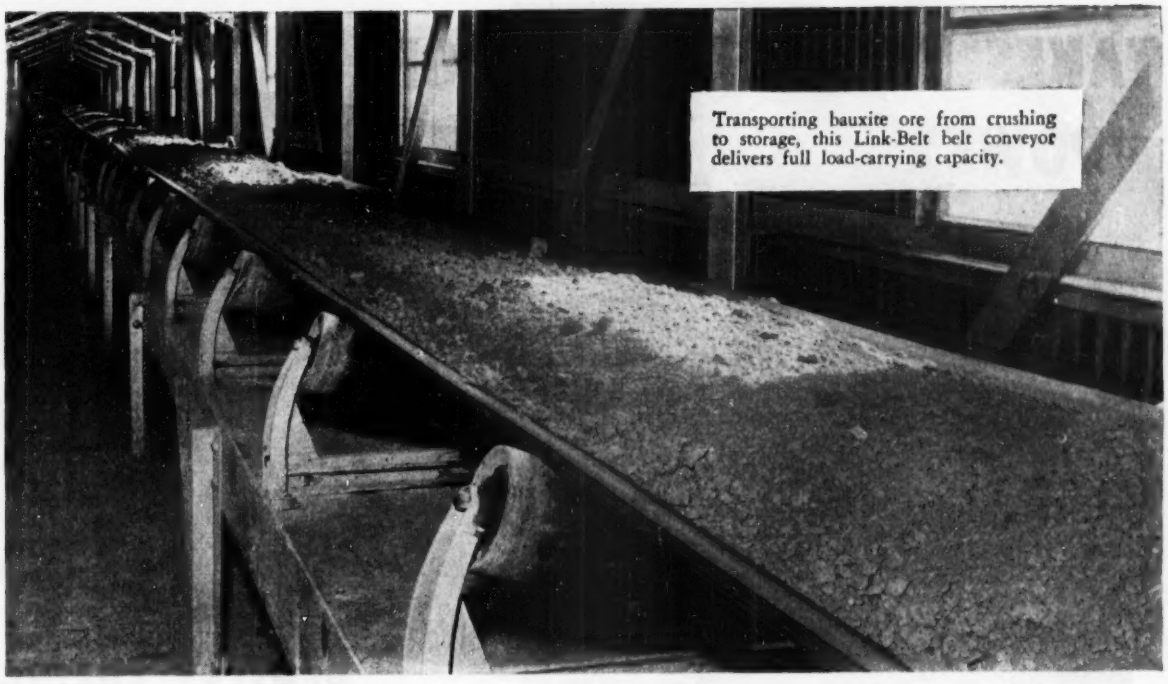
This accelerated laboratory test is one proof that the weld area of Republic ELECTRUNITE Stainless Steel Tubing and Pipe is as corrosion-resistant as the balance of the tube wall. More evidence is the fact that Republic has been supplying stainless steel tubing and pipe in all types of processing equipment for the past 25 years.

You can profit from these ELECTRUNITE advantages, whether you choose pressure tubes in carbon or stainless steel analyses. For complete data, write to:

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
203 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC STEEL

Republic
ELECTRUNITE
STAINLESS STEEL TUBING AND PIPE



Transporting bauxite ore from crushing to storage, this Link-Belt belt conveyor delivers full load-carrying capacity.

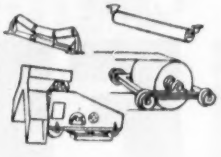
SURE ROAD TO LOWER HANDLING COSTS

... carry the load via Link-Belt belt conveyors

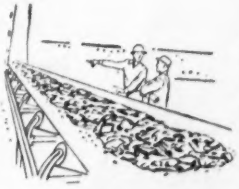
LINK-BELT offers you the "total engineering" so necessary for top efficiency

DESIGNED FOR OVERALL EFFICIENCY—Because of its unrivaled experience, Link-Belt can do a better job of gathering and analyzing all data. Proposals reflect this understanding of the most practical way to fit individual conveyors into your overall system requirements for best results.

BUILT FOR LONG-LIFE PERFORMANCE—Link-Belt manufactures all components and related feeders and conveyors. You are assured of the right equipment because of this breadth of line. And Link-Belt will supply the highest grade belts engineered to the specific job.



DELIVERS FULL RATED CAPACITY—Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews at the customer's request.



ASSURES SATISFACTORY PERFORMANCE—When you rely on Link-Belt as a single source for your complete system, we accept responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems. For all the facts call your nearby Link-Belt sales representative.

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

13.466-A

TAKES THE [illegible] OUT OF POWER

PENFLEX TUBING

"SOAKS UP" VIBRATION . . . PROVIDES SMOOTHER COOLING OPERATION

WHEN A 16-cylinder, 1,750-hp diesel engine roars into action, the air-cooling and circulation piping really has to "take it." This particular installation performs perfectly because it is equipped with Penflex Flexible Metallic Tubing. A 5-foot length of air-jacketed 14" interlocked Penflex Tubing reaches from exhaust to stack. Its tough, rugged, "seep-proof" construction holds exhausts tight as a pipe . . . yet it is flexible enough to absorb the constant vibration.

In the power field you have many calls for Penflex—for air and gas lines, for transmission of oil, steam, and liquids. There is a complete line of steel, bronze, and aluminum Penflex Flexible Tubing, Hose and Couplings in sizes from 1/8" to 24" I.D.

Write today for new illustrated data book on "Flexineering"—the science of engineering flexible tubing to your specific job.

Pennsylvania Flexible Metallic Tubing Company, Inc.
7234 Powers Lane, Phila. 42, Pa.
Offices: Boston • New York • Chicago • Houston • Cleveland • Los Angeles

PENFLEX

HEART OF INDUSTRY'S LIFE LINES

SPEED CONTROL

FOR

AUTOMATIC PRODUCTION

WITH

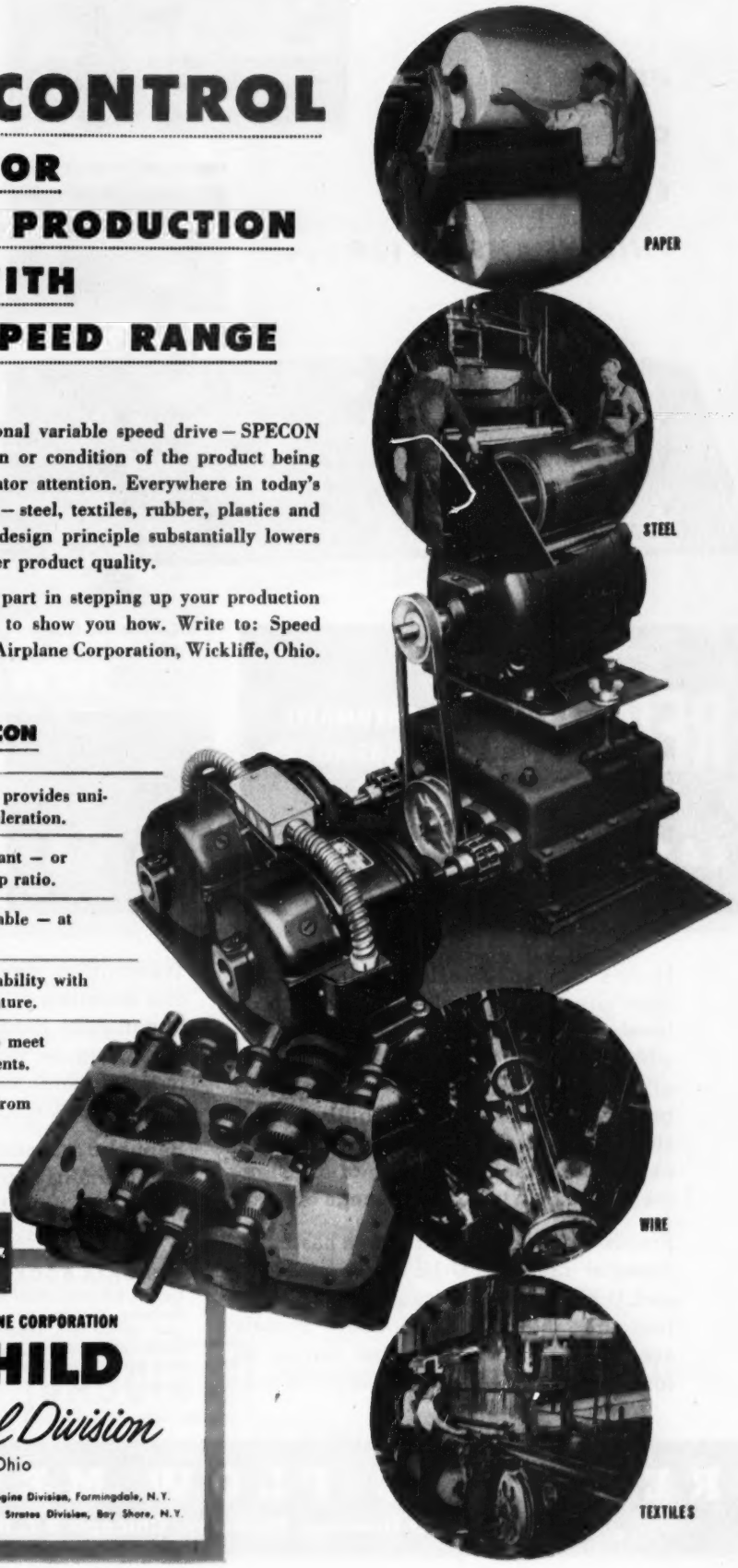
INFINITE SPEED RANGE

Completely unlike any conventional variable speed drive – SPECON controls production by the action or condition of the product being processed – with minimum operator attention. Everywhere in today's high speed industrial operations – steel, textiles, rubber, plastics and paper are but a few – this new design principle substantially lowers operating costs and assures higher product quality.

SPECON can play an important part in stepping up your production efficiency, too. We'll be pleased to show you how. Write to: Speed Control Div., Fairchild Engine & Airplane Corporation, Wickliffe, Ohio.

FEATURES OF SPECON

- ★ **Instant automatic performance provides uniform uninterrupted speed acceleration.**
- ★ **Winding tension may be constant – or tapered for any desired build-up ratio.**
- ★ **Full torque continuously available – at low and zero speeds.**
- ★ **Unequalled safety and dependability with unique, positive adjustment feature.**
- ★ **Easy on-the-spot adjustments to meet changing production requirements.**
- ★ **Minimum maintenance results from standard interchangeable gears and motors.**



ENGINE AND AIRPLANE CORPORATION

FAIRCHILD

Speed Control Division

Wickliffe, Ohio

Aircraft Division, Hagerstown, Maryland · Engine Division, Farmingdale, N.Y.
Guided Missiles Division, Wyandanch, N. Y. · Stratos Division, Bay Shore, N.Y.

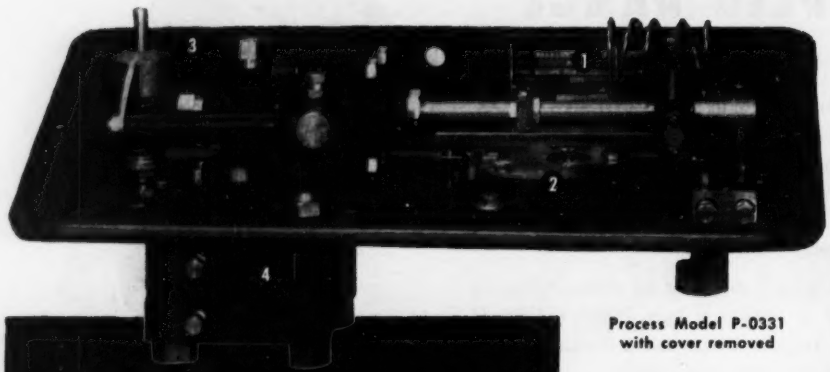
PROCESS CHANGES CAN'T OBSOLETE THIS TRANSMITTER . . .

❶ 10-1 RANGE CHANGE —NO CHANGE OF PARTS

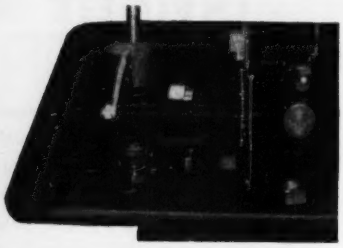
Double weighbeam construction on many models permits range changes as much as 10-1, just by turning a set of locking nuts to change a fulcrum point.

❷ ADDITIONAL 16-1 RANGE CHANGE—STILL NO PARTS CHANGE

Range may be changed on all models by loosening retaining bolts and sliding the reaction chamber to a new leverage position. Reaction area may be changed for further range change.



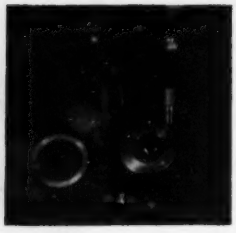
Process Model P-0331 with cover removed



❸ SUPPRESS, COMPOUND OR REVERSE RANGES

Balancing spring, installed to exert either an upward or downward force on transmitter weighbeam, quickly converts transmitter for range suppressions up to 80% of total range, for reversed ranges or for compound ranges where pressure fluctuates above and below atmospheric pressure.

REPUBLIC PNEUMATIC TRANSMITTER with EASY RANGE CHANGE



❹ MAJOR RANGE CHANGES

Range change plates may be easily inserted or removed from measuring chamber to change the effective diaphragm area for major range changes. Similar plates may be used also in the reaction chamber for further range change.

Here's the pneumatic transmitter for measuring differential, flow, pressure or level that saves you time and money when operating conditions are not definitely known or processes are likely to be changed. Extreme flexibility of design lets you adapt the same transmitter chassis for almost any range of measurements—often without any change of parts.

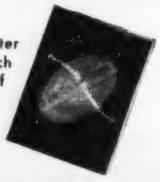
Process Model pictured above has a differential range of 0-12″ H_2O minimum and 0-880″ H_2O maximum at operating pressures to 1500 psig. Other models are available for differential ranges as low as 0-0.6 H_2O or as high as 0-750 psi.

Transmitters may be constructed of special materials to handle almost all types of corrosive fluids. Ruggedly built, they give long service, out-of-doors. Accuracy is guaranteed at ½% of full range on standard models.

Republic transmitters are used in process, chemical and petroleum plants all over the country. Investigate their advantages for your plant.

FREE DATA BOOK

Get the full story about Republic transmitter flexibility. Send for free Data Book which gives all the facts about complete line of Republic transmitters, including Square Root Extracting and Pneumatic Electric models.



REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

The answer to most of your questions about stainless steels are right at your finger tips, when you use Crucible's unique new Stainless Steel Selector.

Want to know the machinability characteristics of a stainless grade? Resistance to corrosion or scaling? Physical or mechanical properties? You can get the answers to these and other questions simply by setting the arrow on the Selector slide at the proper window. It's just as quick and easy as that.

And almost as fast as you get the answer, you can get the steel you need. For many of the REZISTAL stainless steels shown on the Selector are carried in stock in Crucible warehouses conveniently located throughout the country.

To get your free copy just fill in and mail the coupon. Better do it now.

HOW THE SELECTOR WORKS:

Start with the problem. For example, resistance to corrosion in contact with copper sulfate. Just set the slide at the proper index number shown on the Selector (in this case on the back), and you have the answer in a second – grades 302 and 316 are fully resistant to this form of attack.

Crucible Steel Company of America
Dept. C, Henry W. Oliver Building
Pittsburgh, Pa.

Name_____

Company_____ Title_____

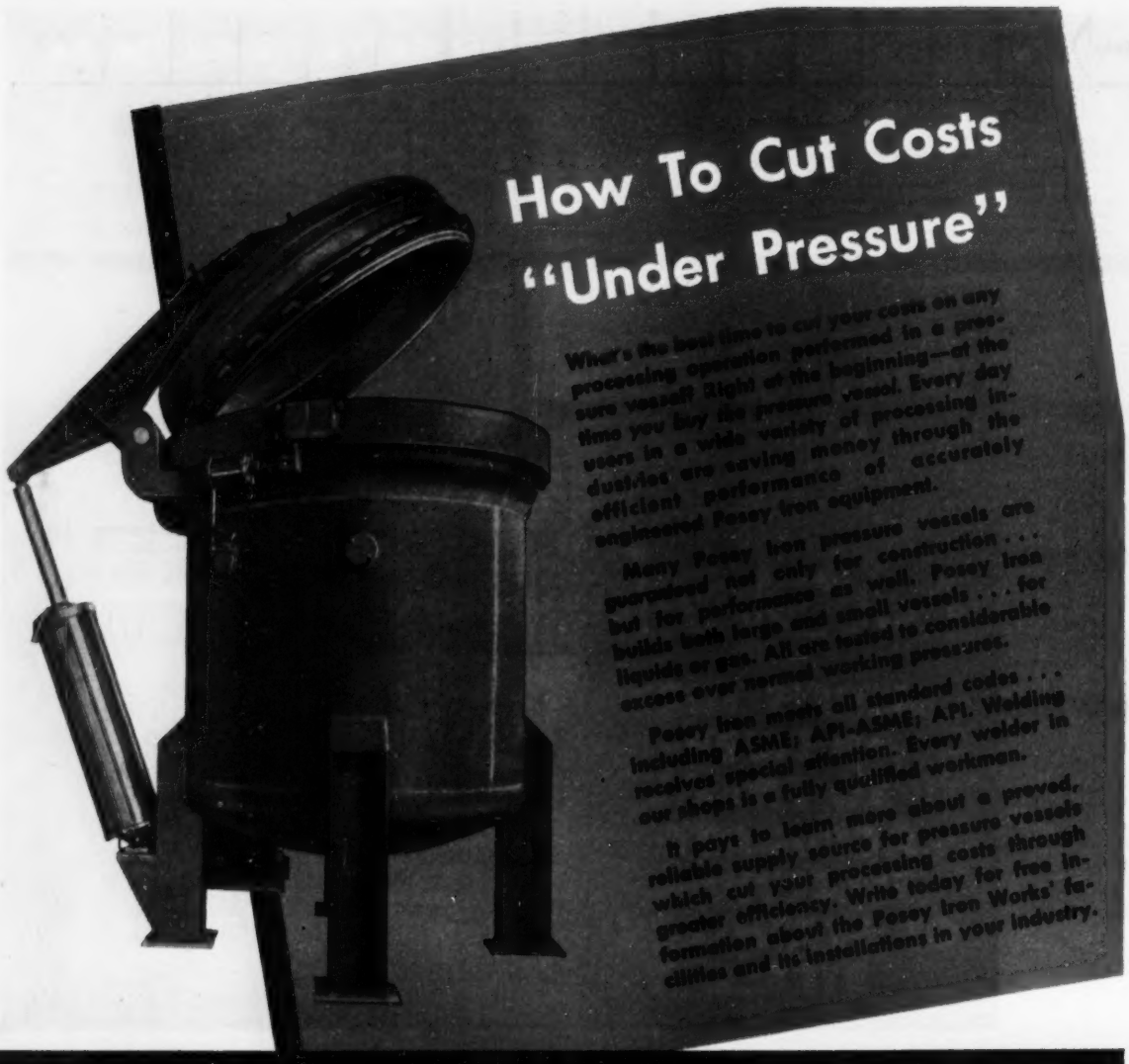
Address_____ City_____ State_____

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **STAINLESS STEELS**

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • MAX-EL • ALLOY • SPECIAL PURPOSE STEELS



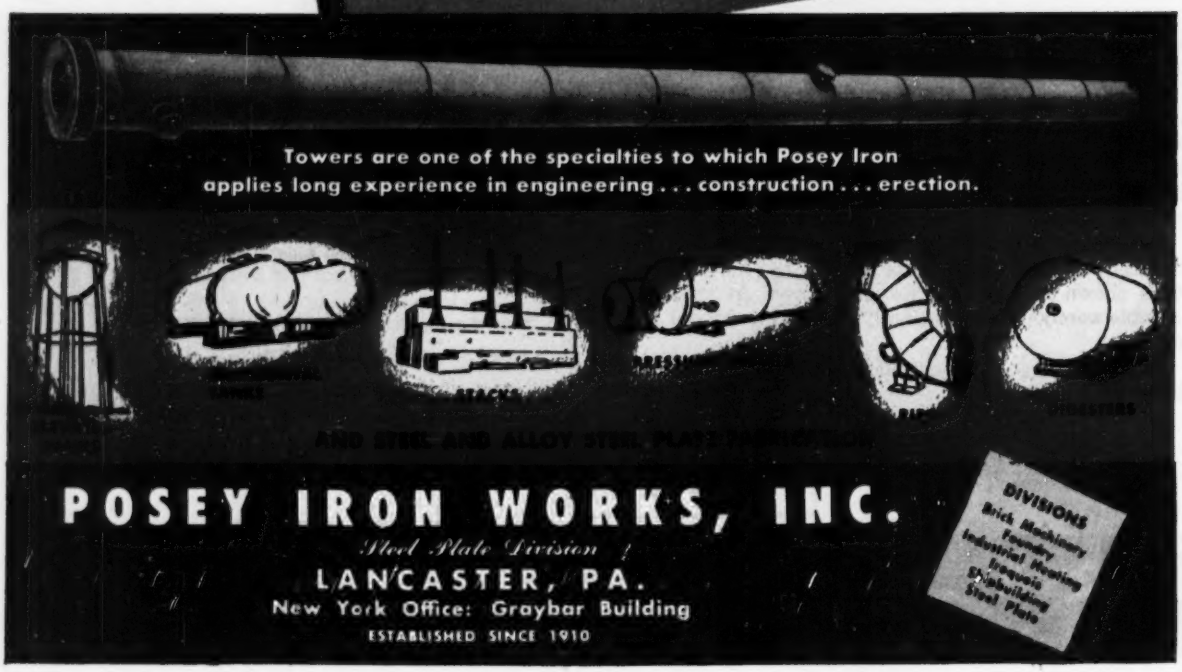
How To Cut Costs "Under Pressure"

What's the best time to cut your costs on any processing operation performed in a pressure vessel? Right at the beginning—at the time you buy the pressure vessel. Every day users in a wide variety of processing industries are saving money through the efficient performance of accurately engineered Posey Iron equipment.

Many Posey Iron pressure vessels are guaranteed not only for construction . . . but for performance as well. Posey Iron builds both large and small vessels . . . for liquids or gas. All are tested to considerable excess over normal working pressures.

Posey Iron meets all standard codes . . . including ASME; API-ASME; API. Welding receives special attention. Every welder in our shops is a fully qualified workman.

It pays to learn more about a proved, reliable supply source for pressure vessels which cut your processing costs through greater efficiency. Write today for free information about the Posey Iron Works' facilities and its installations in your industry.



Towers are one of the specialties to which Posey Iron applies long experience in engineering . . . construction . . . erection.

AND STEEL AND ALLOY STEEL PLATE FABRICATION

POSEY IRON WORKS, INC.

Steel Plate Division

LANCASTER, PA.

New York Office: Graybar Building

ESTABLISHED SINCE 1910

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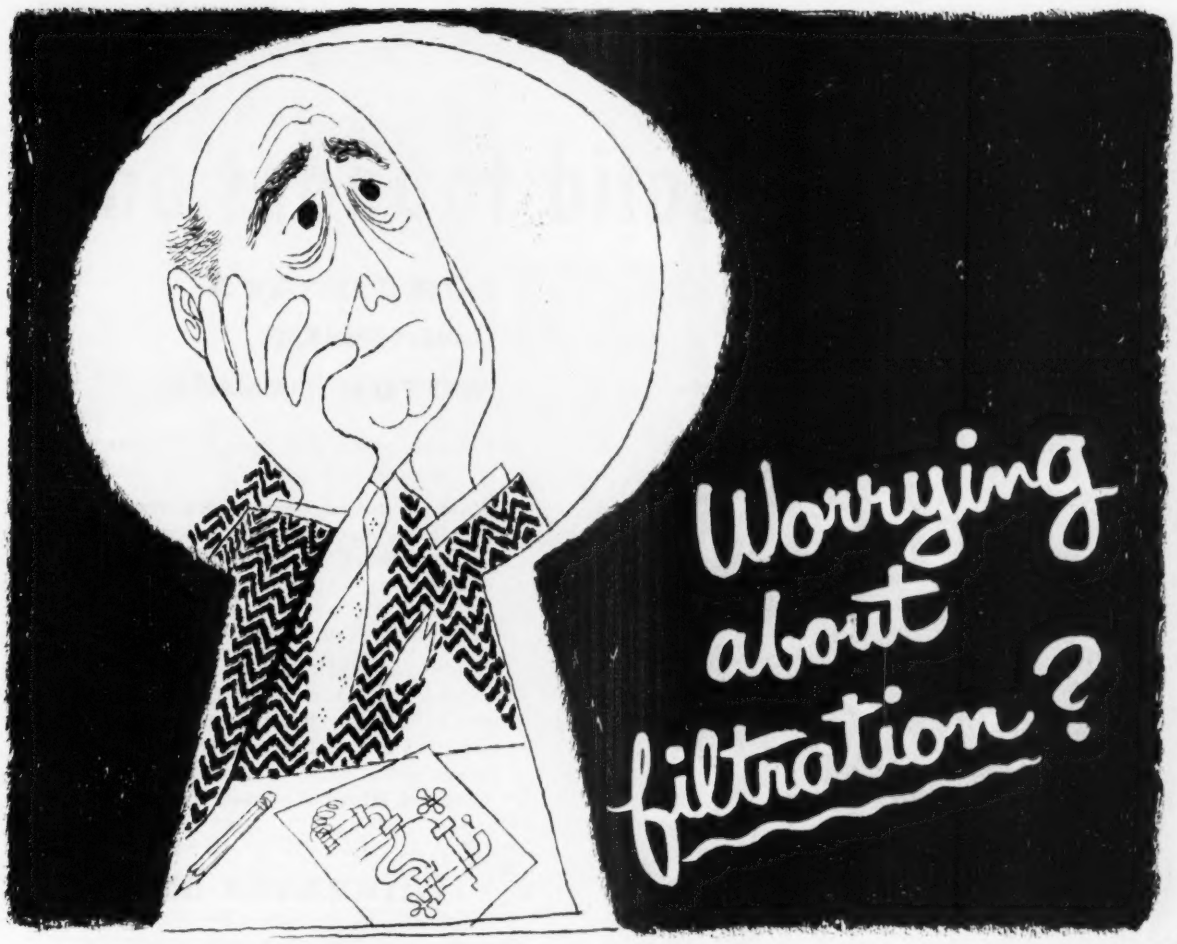
Brick Machinery
Foundry
Industrial Heating
Ironwork
Shipbuilding
Steel Plate



Purolator maintains the world's largest specialized filter research and engineering laboratories

. . . always ready to serve you!

Your filter problems—small or large—are always welcome at Purolator's Engineering Department.

If you find that none of the nearly one thousand types of standard Purolator* filters will fill the bill . . . we'll design one especially for you!

But before you decide on a custom-designed unit, you'll want to study the many kinds of Purolators available on order. The large, illustrated Purolator catalogs are yours for the asking. Just mail us the coupon, indicating which ones you wish.

Whether you need one special filter, or a million of a kind . . . your best source is *Purolator!*

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PUROLATOR PRODUCTS, INC.
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There's a PUROLATOR for every filter need

Lube oil	Air	Foods	Adhesives
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WORLD'S FINEST OIL FILTER

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Send the following Purolator catalogs:

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...solid foundation
FOR TODAY'S COMPACT MOTOR DESIGN
There are, as you know, new NEMA Standards for electric motors ... more power in less space.
When you look for a new NEMA frame motor, look for the one that is built on a solid foundation ... it carries the Fairbanks-Morse Seal of Quality.
The Standards are new .. But the Idea Is Not
Like the recent Fairbanks-Morse developments in other lines, the new F-M motor is the result of a basic engineering philosophy: More Performance in Less Space—a 120-year tradition at Fairbanks-Morse. Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois
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a name worth remembering when you want the best
ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS
NEW LOCOMOTIVE DESIGN
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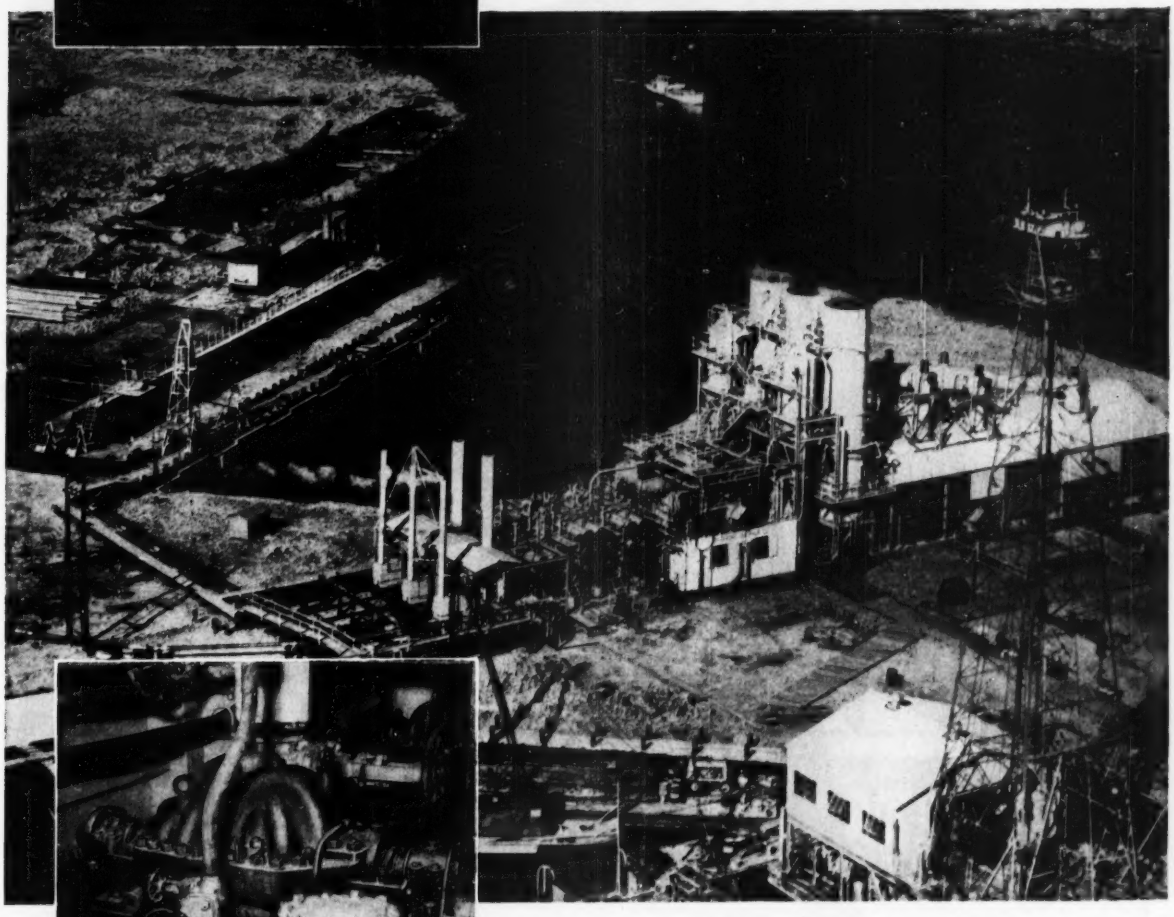
NEW DIESEL DESIGN
NEW MOTOR DESIGN
NEW SCALE DESIGN
NEW PUMP DESIGN
NEW

DE LAVAL

OPPELLER PUMPS

are used for boiler feed on floating process plant



Three De Laval Oppeller Boiler Feed Pumps play an important role in the Freeport Sulphur Company's new process which mines sulphur from a deposit beneath the Gulf of Mexico. This floating plant is located in the marshes in Bay Ste. Elaine, Louisiana.

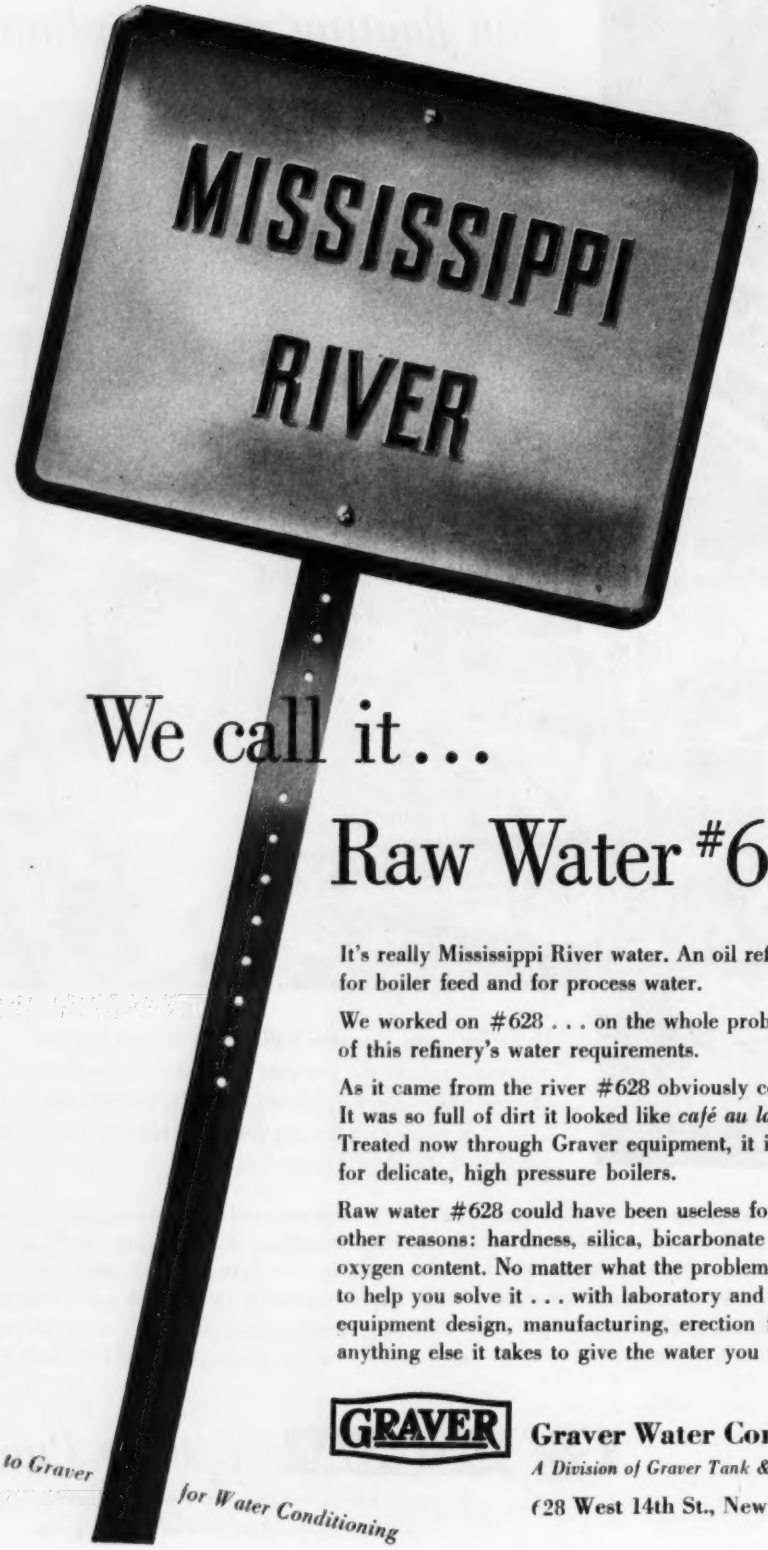
The De Laval Boiler Feed Pumps operate at 3,500 rpm with water heated to 297F. They are built with 12% chrome steel impellers and trim. The dependable performance of these units has led Freeport Sulphur to purchase six additional pumps for boiler feed service at two other mines. In addition to boiler feed, De Laval Oppeller Pumps are used throughout industry for mine dewatering, descaling, desuperheater feed as well as for services in the petroleum, pipeline and marine fields. Capacities range up to 2,000 gpm, pressures to 1,200 psig, temperatures to 350F; materials to suit any service. For complete data, send for Catalog 1502.

DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

DL-200



We call it...

Raw Water #628

It's really Mississippi River water. An oil refinery uses it for boiler feed and for process water.

We worked on #628 . . . on the whole problem of this refinery's water requirements.

As it came from the river #628 obviously could not be used. It was so full of dirt it looked like *café au lait.* Treated now through Graver equipment, it is completely safe for delicate, high pressure boilers.

Raw water #628 could have been useless for any of several other reasons: hardness, silica, bicarbonate alkalinity or oxygen content. No matter what the problem, Graver is in business to help you solve it . . . with laboratory and pilot plant testing, equipment design, manufacturing, erection facilities, and anything else it takes to give the water you want.

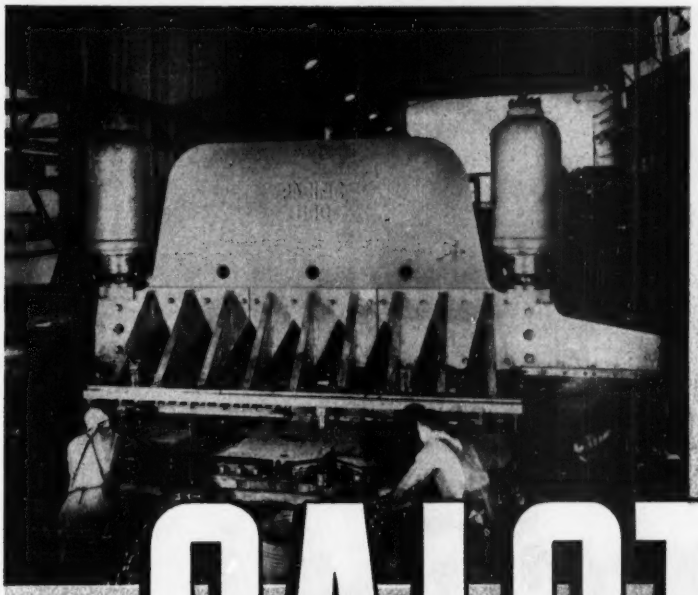
• *Go to Graver for Water Conditioning*

GRAVER **Graver Water Conditioning Co.**

A Division of Graver Tank & Mfg. Co., Inc.

628 West 14th St., New York 11, N. Y.

CUSTOM ENGINEERED FABRICATION



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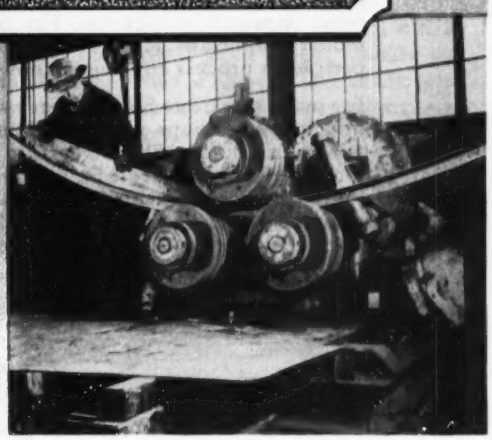
Process, Oil, Gas
Atomic Energy and
Power Industries

CALSTEEL

ENGINEERED FABRICATION

CALSTEEL offers a completely versatile service in custom engineered fabrication, a significant service to meet the most exacting and extensive specifications. CALSTEEL fabricates steel and alloy plate into pipe, tanks, pressure vessels, and all types of special equipment... also structural fabrication to suit the particular needs of both the construction and industrial fields. Call on CALSTEEL for the answer to your problem!



CALIFORNIA STEEL PRODUCTS COMPANY

DIVISION OF AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES: RICHMOND, CALIFORNIA • PLANTS IN RICHMOND, CALIF. & NORTH TONAWANDA, N. Y.

District Offices: San Francisco • New York • Chicago • Philadelphia • Pittsburgh • Cleveland • Detroit • Buffalo

Fractions
SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95'7" crude tower shown in the photograph, ready for shipment, is a representative example.

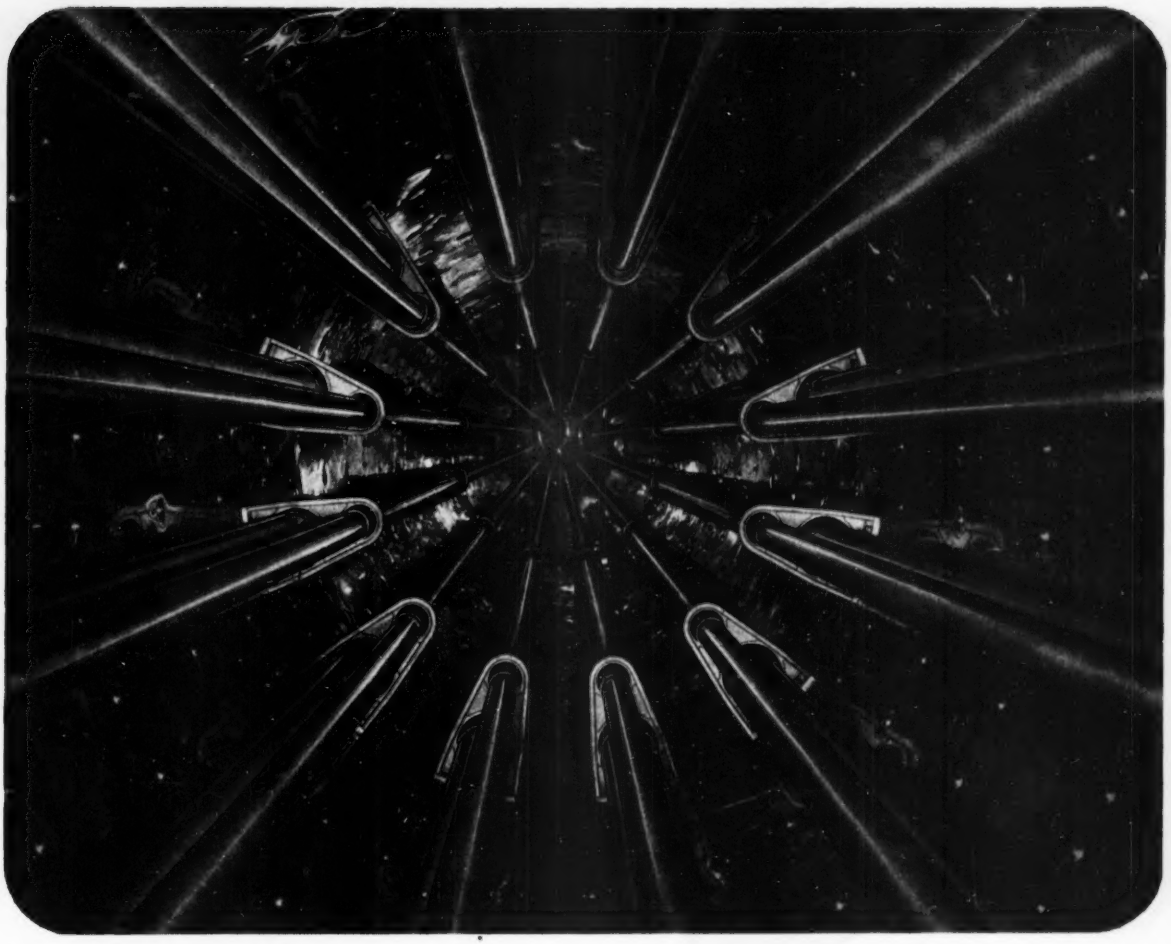
Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE [redacted] **CHESTER, PA.**

25 BROADWAY • NEW YORK CITY



TRENTWELD STAINLESS TUBING gives longer operating life...

FREE—Write for your copy of the new TRENTWELD price calculator. Just a tug at the selector slide gives you complete price information and weight per foot of the tubing size and grade you need. Better send for your free copy now.

TRENTWELD stainless steel tubing gives economical, trouble-free service over long periods of use. It's an ideal choice, for example, for applications such as the 60-foot rotary kiln dryer you are looking into in the photograph above . . . operating at high temperatures and where corrosive conditions are encountered.

In fact, you just can't buy better tubing than TRENTWELD for any application. That's because TRENTWELD stainless and high-alloy *welded* tubing is a product of tube mill specialists. Each tube has a uniformly sound weld indistinguishable from the parent metal and just as strong and corrosion-resistant.

Whether or not your job is as large and complex as a rotary dryer, you can specify TRENTWELD tubing with confidence. And when it comes to tubing sizes and finishes, Trent offers the widest range in the industry . . . from ⅛" to 40" O.D. and up. Next time you have a job involving tubing, remember—you can make it better with TRENTWELD.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

Dust Respirators

GOOD, LIGHTWEIGHT, COMFORTABLE

In the "Good Old Summer Time"

A comfortable worker is a better worker! That's why these lightweight (1½ ounce) respirators are particularly welcome when temperatures soar. They do a real protective job and they're economically priced. Your nearest AO Safety Products Representative can supply you. Model numbers are R9100 and R9100T.

Recommended Uses

R9100 Respirator provides protection against pneumoconiosis-producing and nuisance dusts such as borax, carbon, glass, grain, graphite, cement, limestone, gypsum, coke, charcoal, wood, pollen, flour and aluminum.

R9100T Respirator, similar in appearance and construction to the R9100, protects against any toxic dusts not considerably more toxic than lead—such as arsenate of lead, barium, cadmium, and manganese. It also protects against DDT.

QUICK FACTS

Construction: Simple design includes a smooth, rubber face-contacting mask and a corrugated permanent type felt filter, reinforced by a wire frame.

Filter: Corrugated facepiece forms filter, giving large filter area of approximately 22 square inches.

Breathing comfort: Easy to breathe in — non-reversing, low-resistance exhalation valve does not stick, is out of way and easily replaceable.

Wearing comfort: In addition to light weight, comfort features include soft rubber, smooth edges and self-adjusting double headband.

Unobstructed visibility: Compact, fits close to face. May be worn under helmet or with goggles.

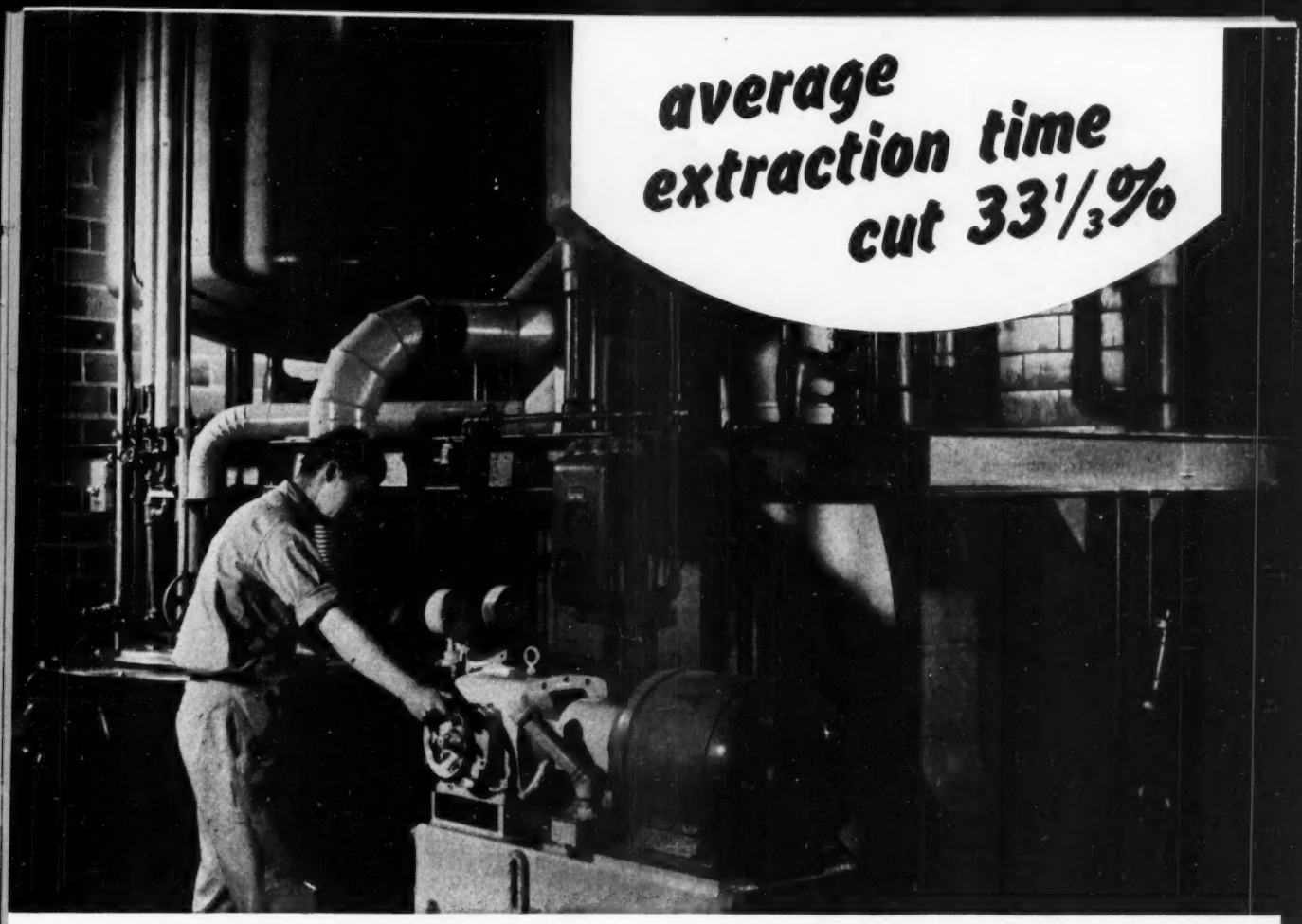
Easily cleaned: A vigorous shake, a slap of the hand or a light blast from an air hose removes dust.

Both respirators are approved by the U. S. Bureau of Mines (R9100 — BM2137; R9100T — BM2144).

Look to AO for a complete line of safety goggles, protective clothing and respirators for every industrial need.

American Optical

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES



Once more the ANY-SPEED Oilgear Drive betters machine performance "painlessly"

Many times in our experience the performance of an already highly efficient machine has been bettered without redesign, solely by changing the drive. One case out of many *varied* cases, is the Tolhurst Centrifugal pictured above, located in a great pharmaceutical house. This centrifugal was originally equipped with a two-speed electric motor drive. However the chemicals it is called upon to handle have widely varying crystal packing characteristics. Some of these crystals packed so densely at the speed available, extraction was inhibited, extraction time far out of balance and crystal removal difficult.

A change was made to an *"ANY-SPEED"* Oilgear Fluid Power Drive. Now the operator is able to shade the speed of the centrifuge experimentally—*and easily discover* the *best* speed for each batch of crystals.

As a result, extracting that used to take from 6 to 9 hours was cut to 4 to 6 hours. The extremely slow speed also available made unloading a great deal easier. This user now has several other Oilgear drives including one on a laboratory centrifuge.

There is very often a direct efficiency coefficient between machine operating speed and the type of work being handled. And we can cite many widely varying instances where equally dramatic and profitable gains resulted at once from a simple change to *"ANY-SPEED"* Oilgear Fluid Power Drives. If you want some interesting factual data on Oilgear's steplessly variable speed drives, their outstanding responsiveness to control impulses, their smooth acceleration and deceleration, talk to an Oilgear Engineering Representative. His mature and sound engineering recommendations may profit you greatly. THE OILGEAR COMPANY, 1579 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

"You see POWELL VALVES everywhere!"

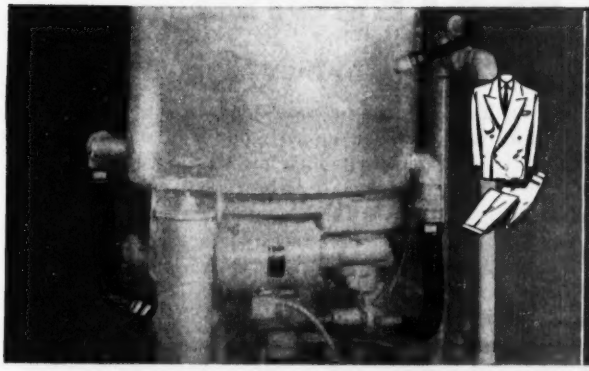
Not surprising when you realize that Powell makes more kinds of valves and has probably solved more valve problems than any other organization in the world. And this has been going on since 1846.

Wherever flow requires dependable control, there's the place for Powell Valves—available through distributors in principal cities. Made ⅛" to 30" and 125 pounds to 2500 pounds W. S. P. Bronze, iron, steel and corrosion resistant alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

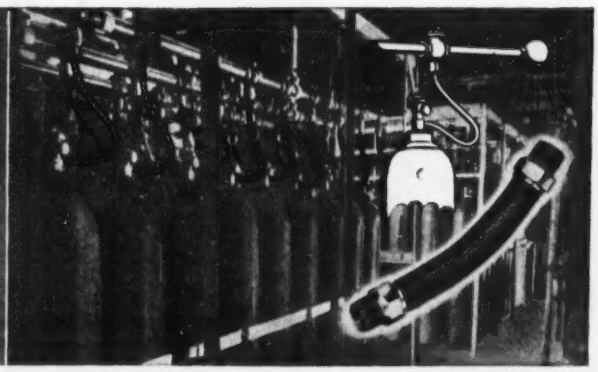
CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves ... 108th year

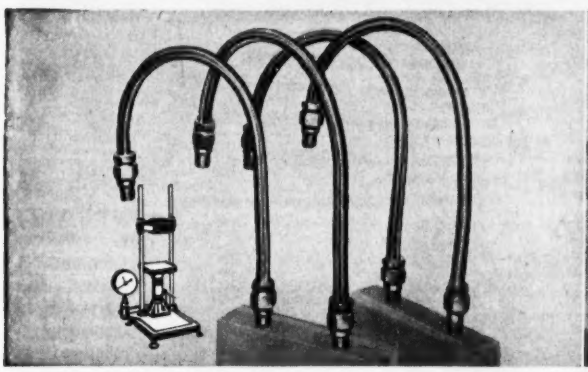
Pick an idea—lick a design problem...



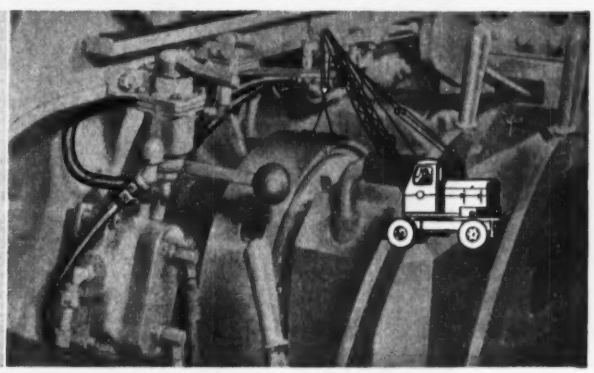
END VIBRATION AND LEAKAGE. Titeflex® metal hose, used as fill and drain lines of SEC Synthetic Cleaning Units, kills vibration and prevents solvent leakage at fittings. Tough, wear-and-corrosion-resistant Titeflex is just as effective in handling steam, oil, lubricants, fuels, gases, brine, acids, compressed air or oxygen. Design and construction of Titeflex assure trouble-free performance. Excellent for projects involving extreme configurations.



CONTROL CRITICAL PRESSURES. How would you connect 280 cylinders of fire-extinguishing carbon dioxide at 850 psi to line? Walter Kidde & Company licked this problem with Titeflex flexible metal hose which met all insurance standards and withstood rigid application requirements. Titeflex also conveys hundreds of different fluids under as many different temperature and pressure conditions. Resists corrosion, vibration, physical abuse.



CONDUCT STEAM SAFELY. Plates for Carver Laboratory Press carry steam up to 200 psi (nearly 400°F.) for heating—water for cooling. The connections are flexible, pressure-safe Titeflex. Braiding gives extra strength. Added problems of vibration, pulsation, continuous movement, corrosion or abrasion make Titeflex invaluable in scores of other applications.



FIGHT FATIGUE AND WEAR. Titeflex metal hose eliminated maintenance on air control lines of Unit Mobile Cranes. All-metal construction, with braiding woven directly upon the hose, provides great strength and resistance to vibration, corrosion, wear and abuse. Flexibility of Titeflex permits simplified assembly even where space configurations are problems.

THE USES FOR TITEFLEX® seamed flexible metal hose and Uniflex seamless flexible metal hose are limited only by engineering ingenuity. And Titeflex design engineers—working *with* customers—develop new applications daily. Somewhere in your plant or on your products Titeflex can improve operation and maintenance—or simplify a design problem. Our *new 48-page Metal Hose Catalog* No. 200 shows you how and why. To get your free copy, simply mail the coupon.

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Please send me without cost information about the products checked at the left

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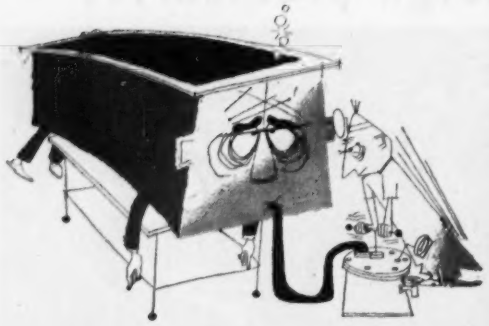
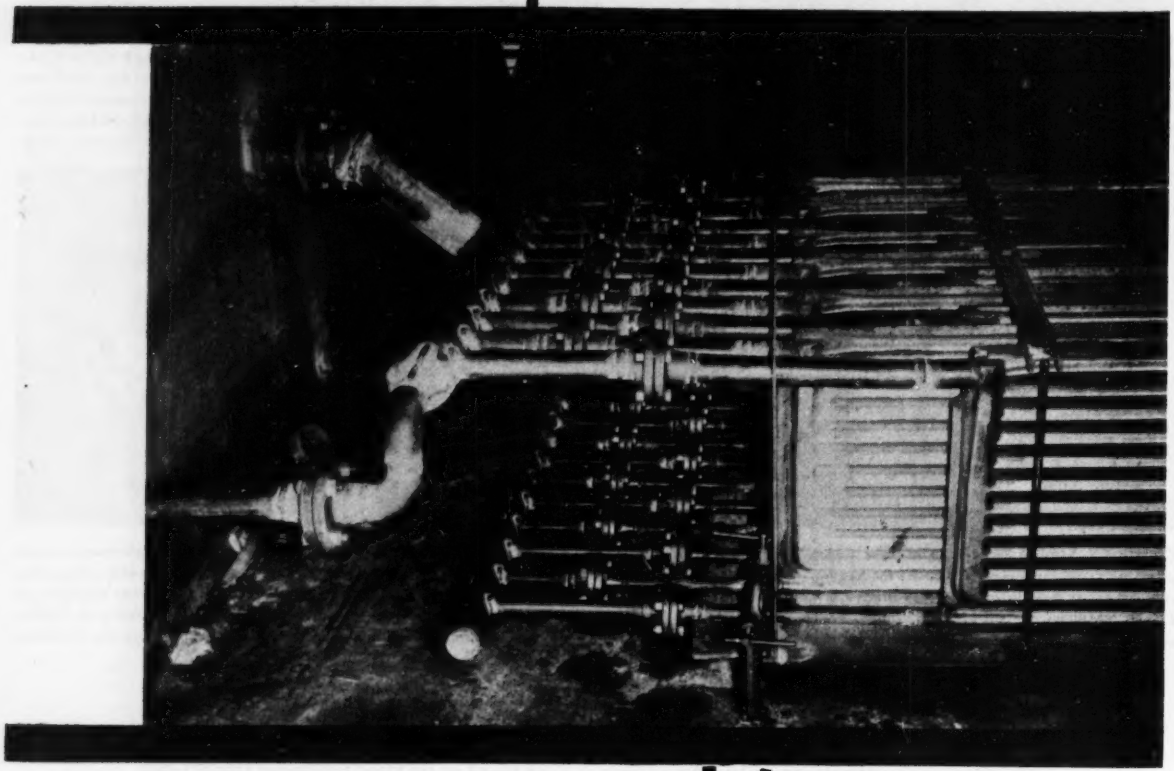


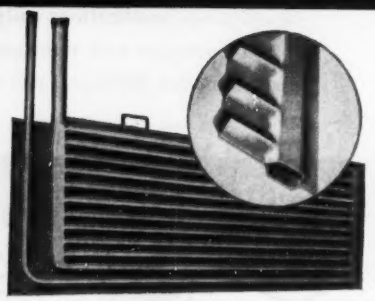
steam costs cut 96% as PLATECOILS cure coil-itis *

Old Colony Tar Company cut their steam costs 96% and saved a full week heat-up time per removal by replacing pipe coils with Platecoils in their tar storage tanks. It took a week for the pipe coils to heat a 250,000 gallon tank to pumping temperature . . . now, with the Platecoils, there is no heat-up time required. It cost $100.00 per removal for steam . . . now steam costs have been cut to $4.00 per removal, and $96.00 is saved. This installation is described in detail in Bulletin P61 shown below.

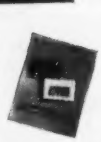


PLATECOILS replace pipe coils for 50% of the cost

* Coil-itis is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference as Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old fashioned and outmoded pipe coils.

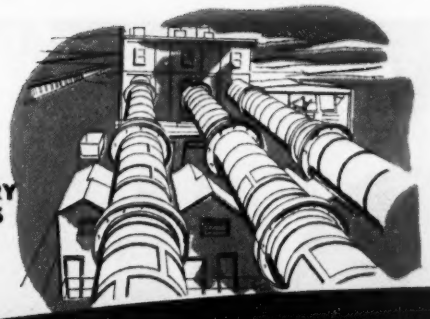


Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.



Platecoil Division, TRANTER MANUFACTURING, Inc., Lansing 4, Michigan

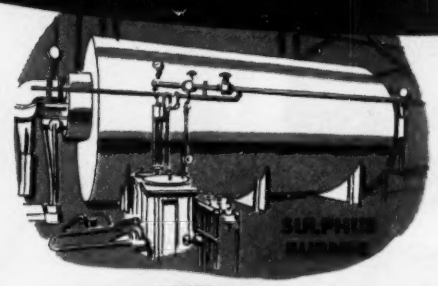
For fast shipment see your local distributor



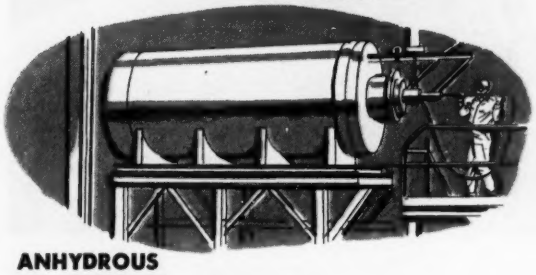
ROTARY KILNS

Harbison-Walker

REFRACTORIES



for every type of chemical processing furnace . . .

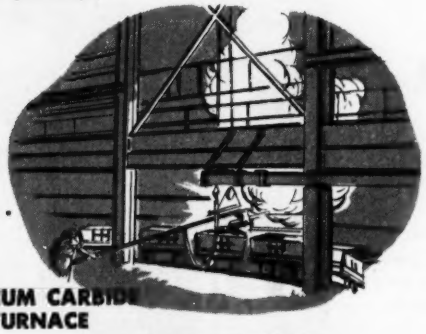


ANHYDROUS HCL FURNACE

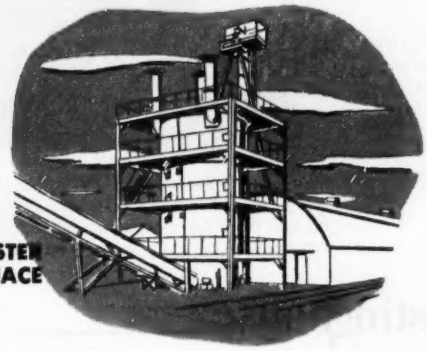
In many chemical processing operations, high temperatures, spalling conditions, abrasive action and chemical attack combine their individual destructive factors to impose exceptionally severe treatment on refractory linings in kilns, roasters and other types of furnaces.

To meet the wide variety of conditions that exist in chemical processing applications, Harbison-Walker offers a complete line of refractories from which can be selected the exact types and brands needed for longest life and most economical service in every part of the furnace.

Our Technical Service Department will be glad to make specific recommendations for your requirements.



CALCIUM CARBIDE FURNACE



ROASTER FURNACE

HARBISON-WALKER REFRACTORIES COMPANY

AND SUBSIDIARIES

World's Largest Producer of Refractories

GENERAL OFFICES

PITTSBURGH 22, PA.

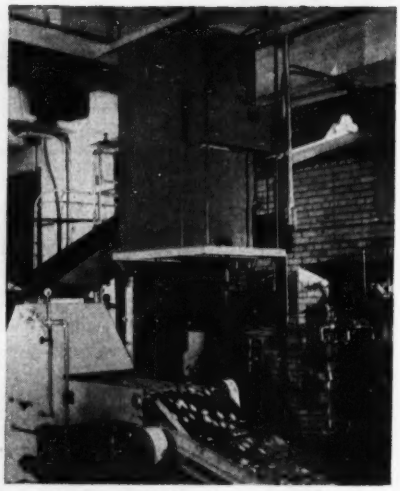
A TASTY BUT DISTRESSING PROBLEM

Felber Biscuit Company in the process of spraying hot cocoanut oil on their delicious Town House crackers,* acquired an unwelcome oil mist problem. A fan exhaust system—installed to clear the air—wasted gallons of costly cocoanut oil and created a dangerous fire threat.

How to flavor these famous crackers without oil-painting the entire building? Felber Biscuit did it with an Oil Mist PRECIPITRON!

Excess oil mist is now drawn into a Westinghouse PRECIPITRON and out of the air completely. Result: mist, mess and fire hazard have disappeared. Valuable cocoanut oil is now salvaged for re-use. Employee working conditions are greatly improved.

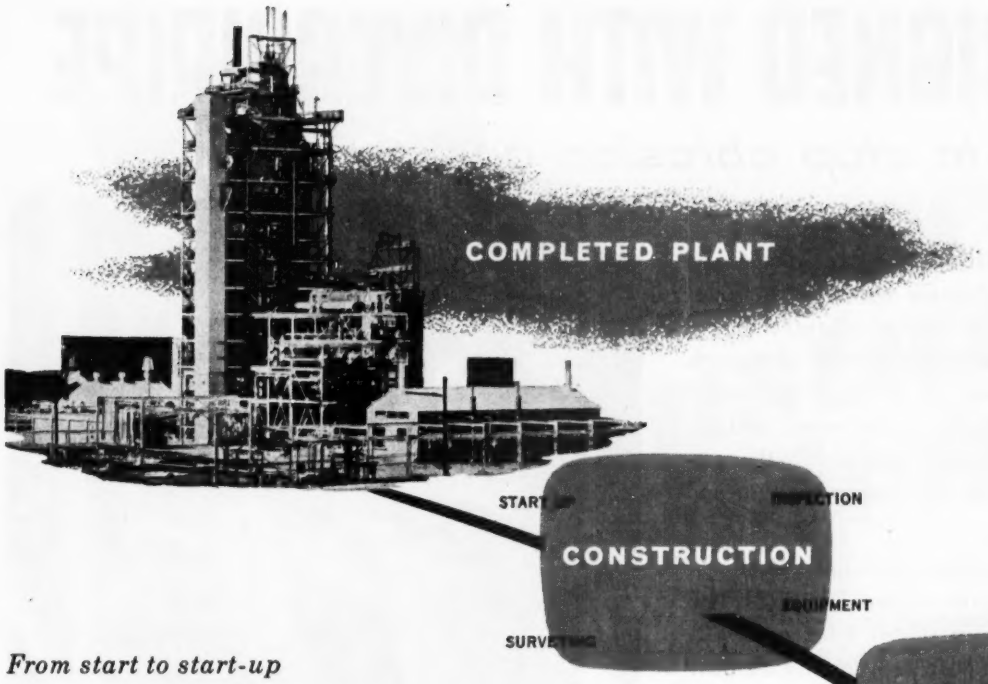
Perhaps Westinghouse PRECIPITRON can draw savings out of the air for *you*. There is a PRECIPITRON for every application for removing contaminants from the air. For an answer to *your* specific air cleaning problem . . . call your nearest Westinghouse-Sturtevant office today. Or write to Sturtevant Division, Westinghouse Electric Corporation, Hyde Park, Boston 36, Mass.



Westinghouse PRECIPITRON suspended directly over the hot cocoanut oil spray collects excess oil mist from the spraying operation. Clean air is returned to the room; valuable oil is reclaimed.

WESTINGHOUSE AIR HANDLING

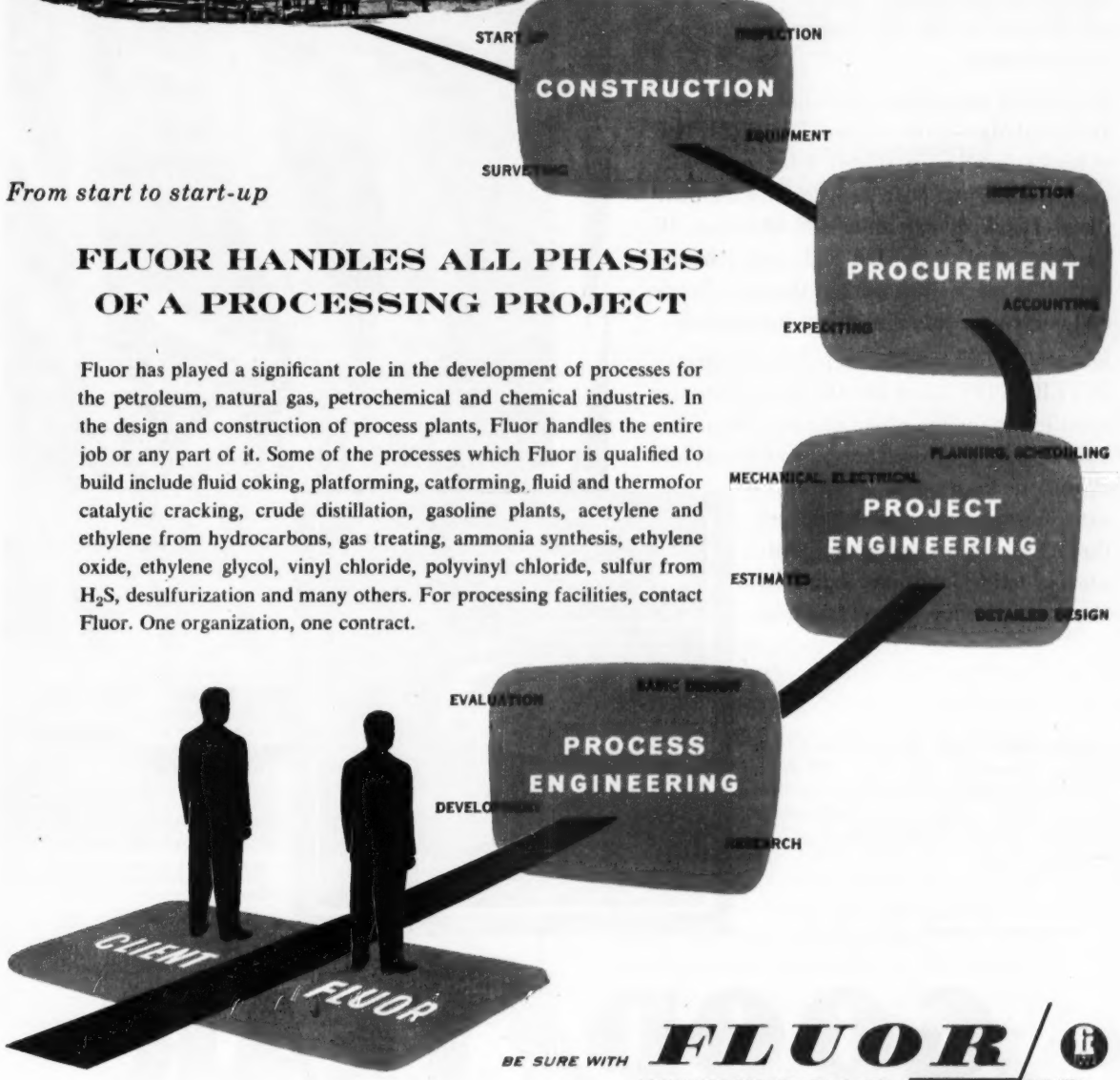
YOU CAN BE SURE... IF IT'S **Westinghouse** J-80332



From start to start-up

FLUOR HANDLES ALL PHASES OF A PROCESSING PROJECT

Fluor has played a significant role in the development of processes for the petroleum, natural gas, petrochemical and chemical industries. In the design and construction of process plants, Fluor handles the entire job or any part of it. Some of the processes which Fluor is qualified to build include fluid coking, platforming, catforming, fluid and thermofor catalytic cracking, crude distillation, gasoline plants, acetylene and ethylene from hydrocarbons, gas treating, ammonia synthesis, ethylene oxide, ethylene glycol, vinyl chloride, polyvinyl chloride, sulfur from H_2S, desulfurization and many others. For processing facilities, contact Fluor. One organization, one contract.



BE SURE WITH **FLUOR**

THE FLUOR CORPORATION, LTD.
LOS ANGELES 22, CALIFORNIA

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TULSA

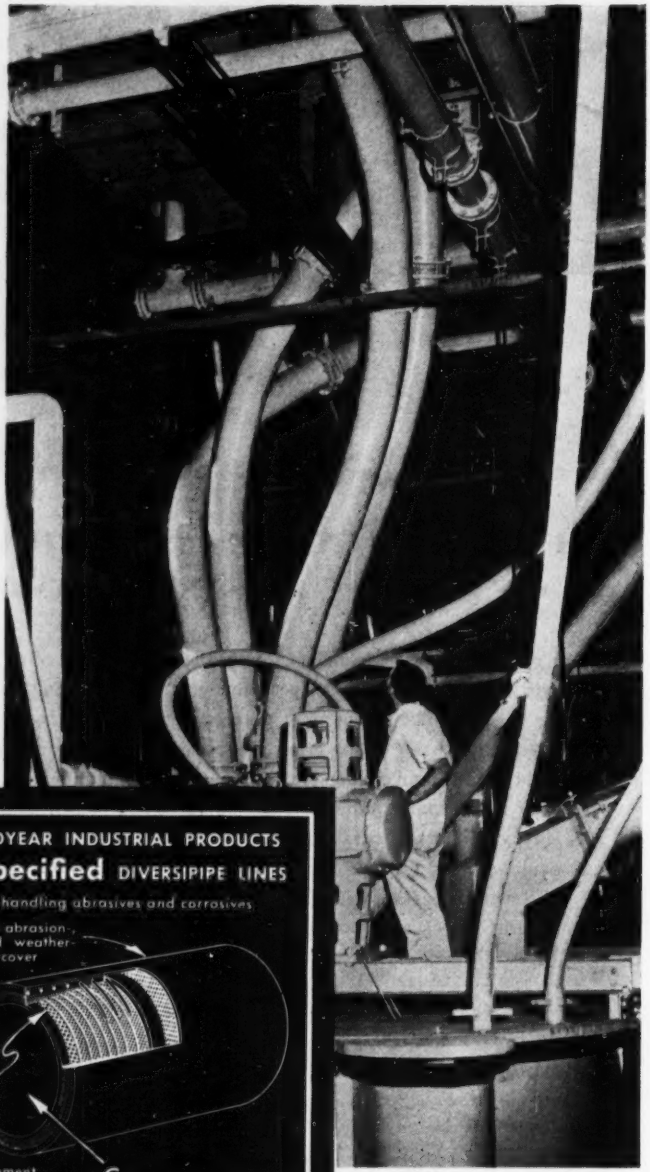
DESIGNED WITH DIVERSIPIPE

—to stop abrasion and corrosion

How to handle huge quantities of an extremely abrasive and corrosive phosphate rock slurry in this agricultural chemical plant was a real problem to its designers. What they needed was a "pipe" that could resist both the highly acidic water and the sharp rock particles, yet lend itself to the complicated layout with a minimum of fitting and prefabrication.

The answer came from the G.T.M.—Goodyear Technical Man—in the form of DIVERSIPIPE — husky, hand-built rubber hose, especially compounded and built to withstand the combined attack of corrosion and abrasion. Its quickly coupled, flanged ends and inherent flexibility made short work of the many bends and curves—greatly simplified installation.

So well satisfied were the engineers with the way DIVERSIPIPE fitted into the plant, they also specified it for the waste disposal line. This half-mile long, cross-country conduit was laid directly on the ground—required no extra fittings. For similar help, see the G.T.M., your Goodyear Distributor, or write Goodyear, Industrial Products Division, Akron 16, Ohio.



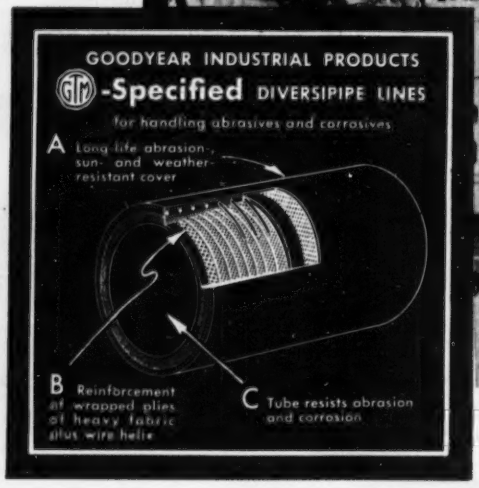

GOODYEAR INDUSTRIAL PRODUCTS
GTM-Specified DIVERSIPIPE LINES
for handling abrasives and corrosives
A Long-life abrasion-, sun- and weather-resistant cover
B Reinforcement of wrapped plies of heavy fabric plus wire helix
C Tube resists abrasion and corrosion

Photo courtesy International Minerals and Chemical Corporation and Rust Engineering Company.

YOUR GOODYEAR DISTRIBUTOR *can quickly supply you with Hose, Flat Belts, V-Belts, Packing or Rolls. Look for him in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods."*

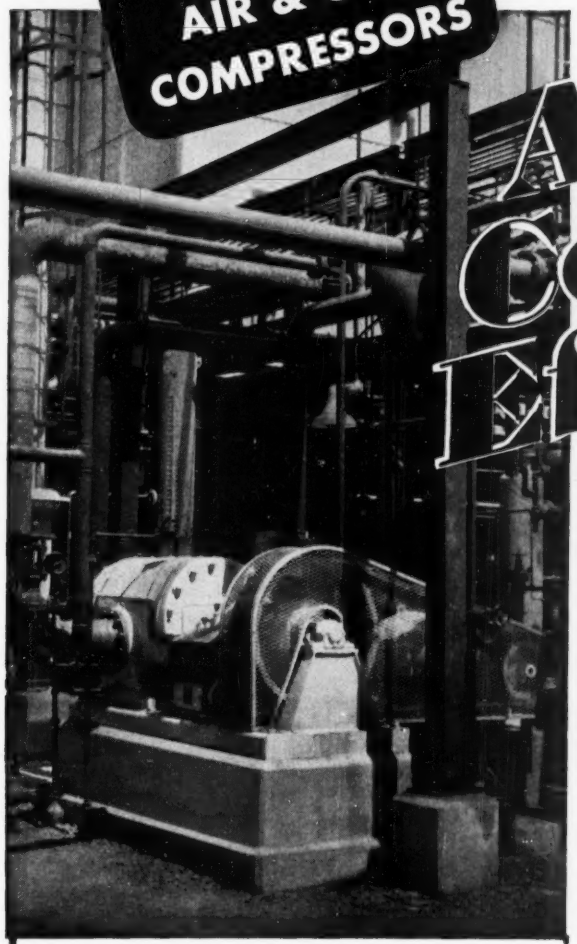
Diversipipe—T. M.
The Goodyear Tire Rubber Company, Akron, Ohio

GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD"—every Sunday—ABC Radio Network—THE GOODYEAR TELEVISION PLAYHOUSE—every other Sunday—NBC TV Network

AIR & GAS COMPRESSORS



Assure Constant Efficiency

Same Pressures Maintained YEAR after YEAR Without Loss of Volume

YOU are assured of constant operating efficiency with *Ro-Flo* air and gas compressors because they are simple in construction with few parts to wear. After years of continuous operation, under normal conditions, *Ro-Flo* units have maintained constant volume output without loss of pressure, and have shown no visible signs of wear.

Today, *Ro-Flo* compressors play an important role in almost all chemical manufacturing. They are compact, self-contained units that provide continuous pulsation-free flow. And their relatively high speed rotary action eliminates vibration and shock — reduces foundation needs to a minimum.

Ro-Flo compressors are built in capacities from 40 to 3200 cfm at pressures from 5 to 40 psig. And they are only one of five separate types of air and gas handling units manufactured by Allis-Chalmers.

For detailed information on an air or gas handling unit to fit your particular need, contact your nearest A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4140

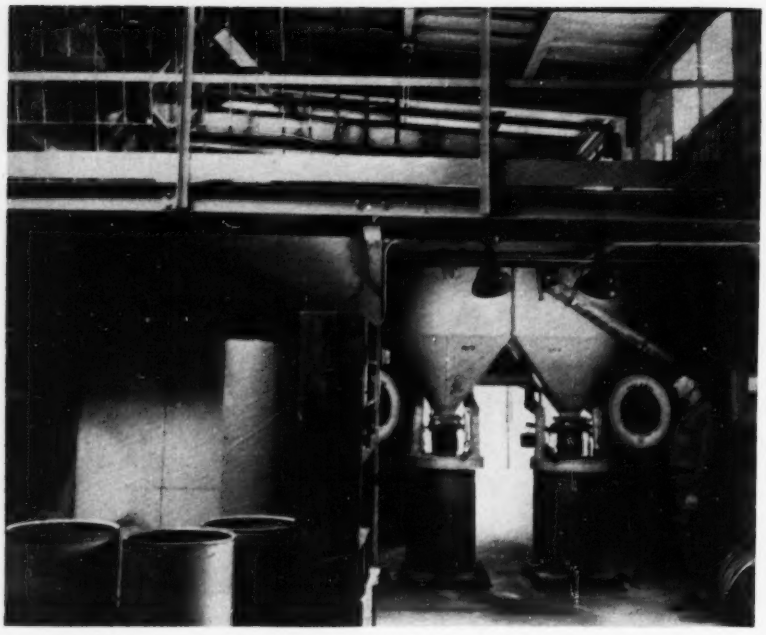
USED IN NEW ACRYLIC PROCESS

In a new acrylic process recently put on stream by the Rohm & Haas Company, Houston, Texas, a *Ro-Flo* gas compressor is handling a composite of hydrogen obtained from a low temperature distillation mixture of carbon monoxide and hydrogen. The new R & H process reduces the costs of methyl and ethyl acrylates — basic materials for synthetic organic chemicals.

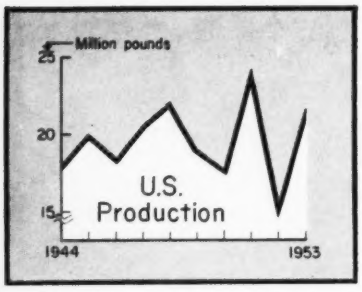
Ro-Flo is an Allis-Chalmers trademark.

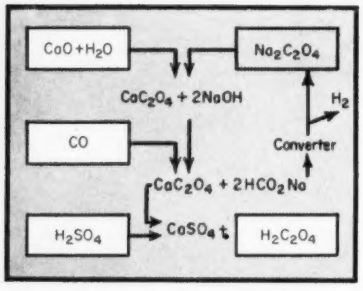
ALLIS-CHALMERS

A-C ALLIS-CHALMERS



SCREENING on upper level, packaging on lower—final steps in production of . . .





OXALIC ACID via the formate process.

Oxalic Acid

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

Here is how Oldbury Electro-Chemical Co. makes oxalic acid. They use the synthetic formate process.

Oxalic acid—textile bleach; chemical intermediate; rust remover—is made synthetically at the Oldbury Electro-Chemical Co. plant, Niagara Falls, N. Y.

In 1953, U. S. production was 21,694,262 lb. and about one-third of this went into rust remover compounds. This rust removal market is an expanding one for oxalic acid—particularly for the cleaning of auto radiators.

Three commercial methods are available for making the acid. One process involves oxidation of sugars. Another is a fermentation procedure—largely as a controllable byproduct of citric acid manufacture.

▶ **Synthetic Process**—By far, the great majority of oxalic acid is made by the synthetic formate process. The flowsheet shows this method, as practiced at Oldbury.

In brief:

1. Sodium oxalate, CO and lime, react to produce sodium formate and insoluble calcium oxalate.

2. The formate is reconverted to sodium oxalate. This is then recycled.

3. Calcium oxalate forms oxalic acid by treatment with sulfuric acid.

▶ **How They Make It**—In an agitated tank, sodium oxalate reacts with a lime slurry. Insoluble calcium oxalate and a sodium hydroxide solution result.

Carbon monoxide (from phosphorus operations) reacts with this mixture (under pressure and high temperature) in an absorber. Sodium hydroxide forms sodium formate (HCOONa). Calcium oxalate remains unchanged.

After separation on a rotary vacuum filter, these two materials part company—dividing into separate streams.

▶ **Sodium Formate Stream**—Concentration of the sodium formate solution takes place in a double effect evaporator. The crystals coming out of solution are dried in a vacuum dryer.

These crystals are carefully and slowly melted (to prevent decomposition). The melt goes quickly to a converter.

Here rapid heating is applied. At 400-500 deg. C., a vigorous, exothermic reaction starts. Hydrogen gas comes off and a light brown powder is produced—crude sodium oxalate.

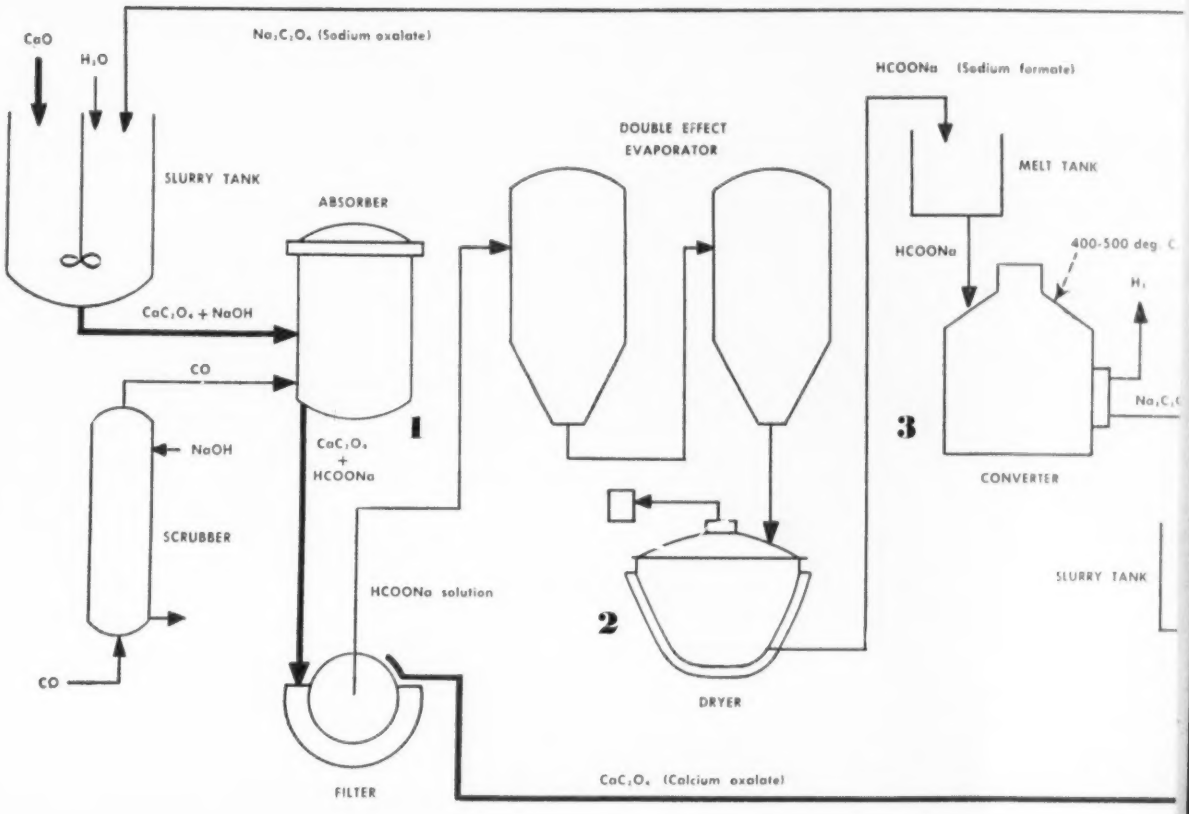
Hydrogen burns off as it escapes from the converter.

The sodium oxalate contains sodium carbonate as a impurity. This is removed by extraction with water in a slurry tank. Sodium oxalate recycles back into the process.

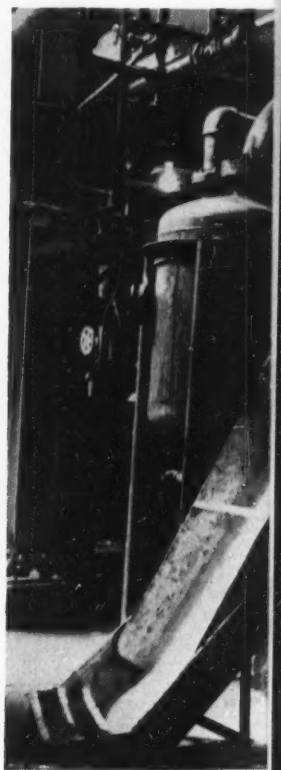
▶ **Oxalic Acid From Calcium Oxalate**—Back at the rotary vacuum filter (after the CO treatment), calcium oxalate comes off as a cake. It's charged to a digester tank and treated with sulfuric acid. The products? Crude oxalic acid. And insoluble calcium sulfate. After separation, the $CaSO_4$ is discarded.

Crystallization, filtration on rubber-lined centrifuges and recrystallization from a water slurry results in a pure grade of oxalic acid.

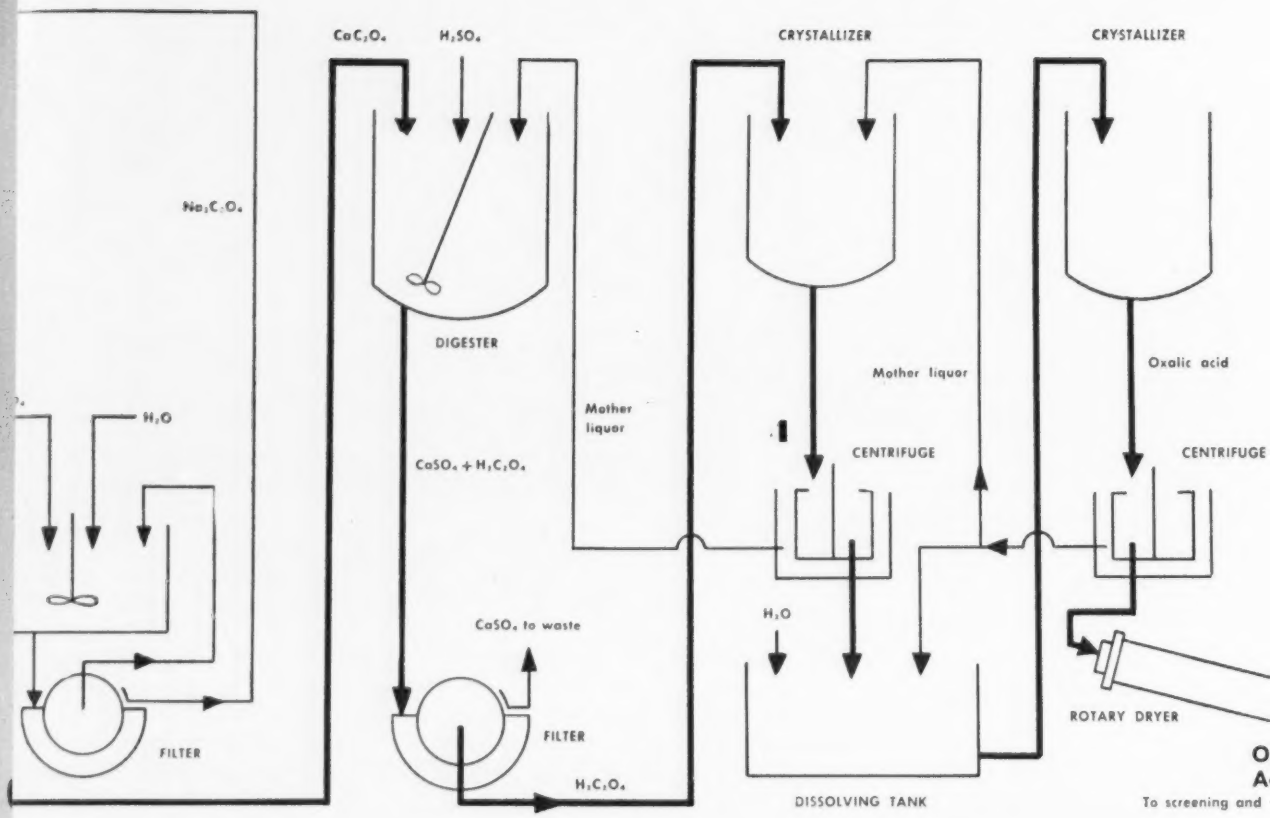
Finally, it's dried in a rotary dryer, and packed for shipping.

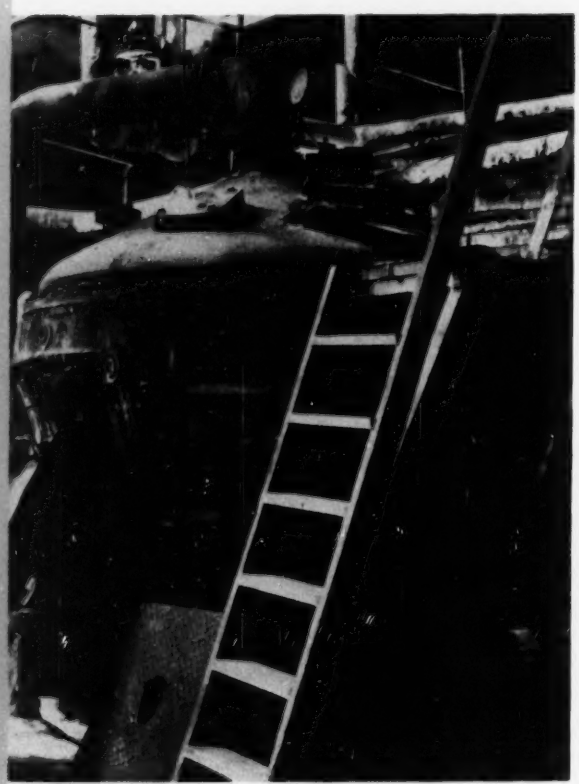


1 ABSORBER where monoxide and caustic react.

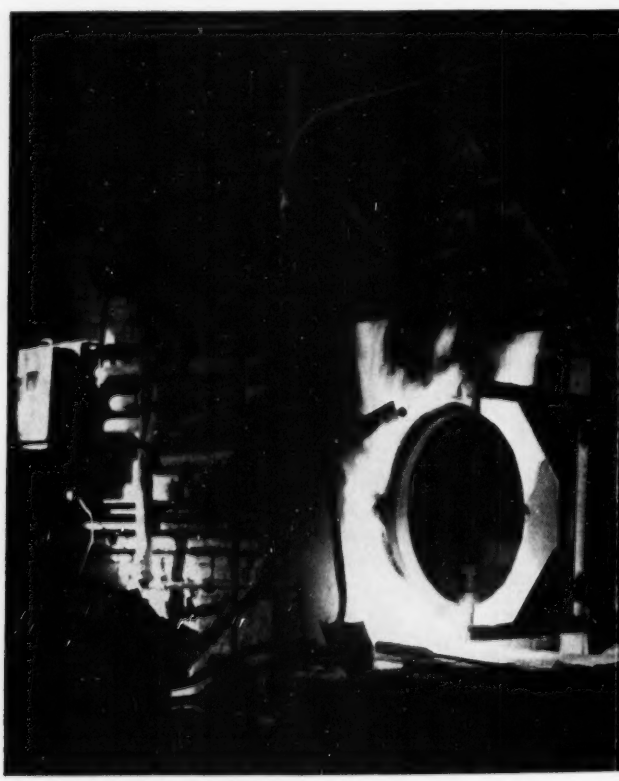


2 VACUUM DRYER rem





oves moisture from formate.

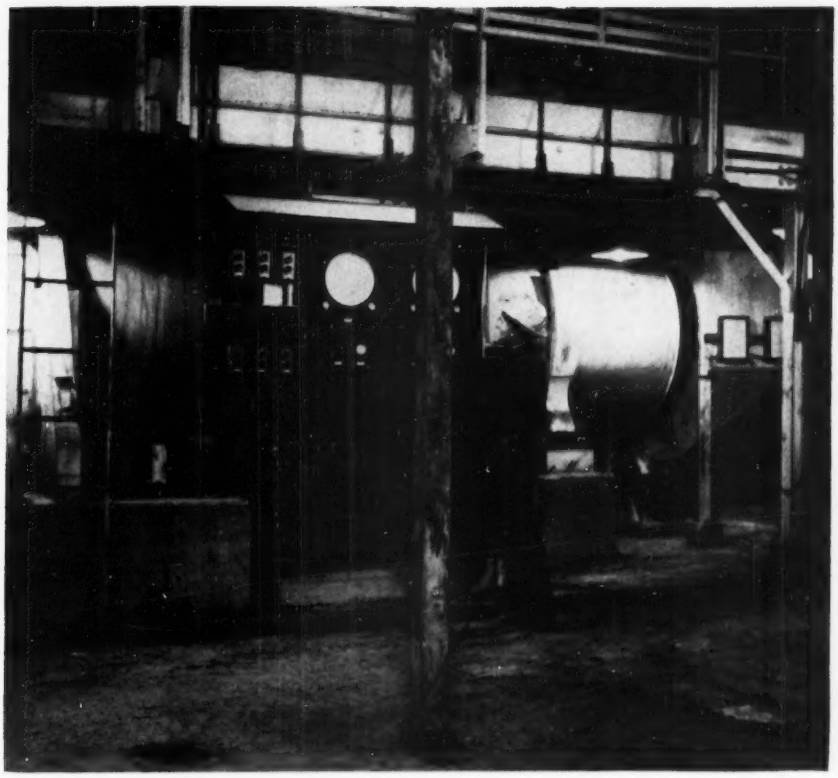


3 CONVERSION of formate to oxalate—H_2 burns off.

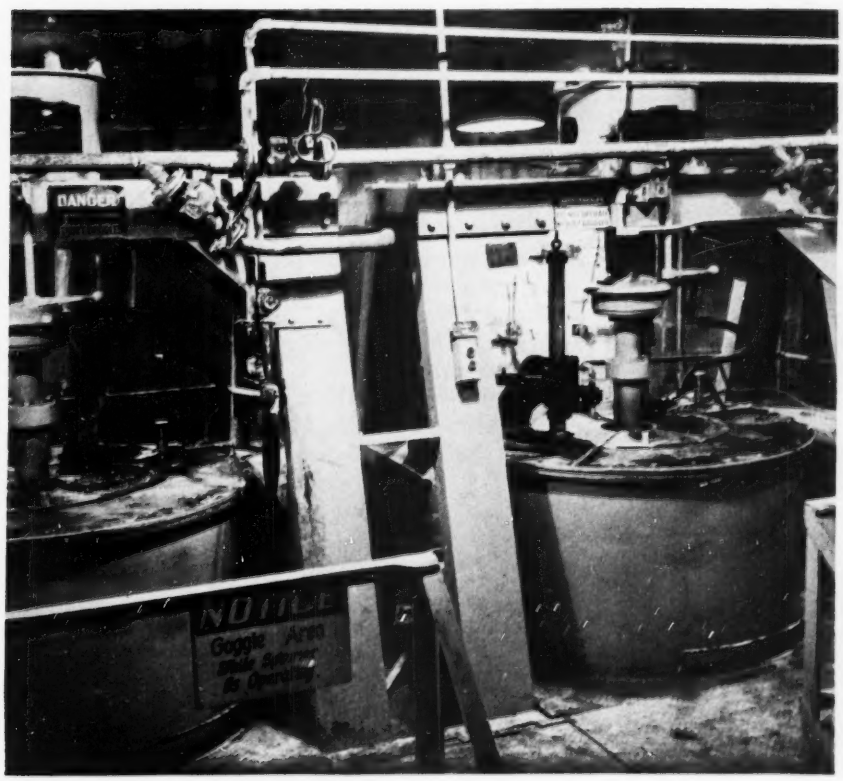
FUGE

5

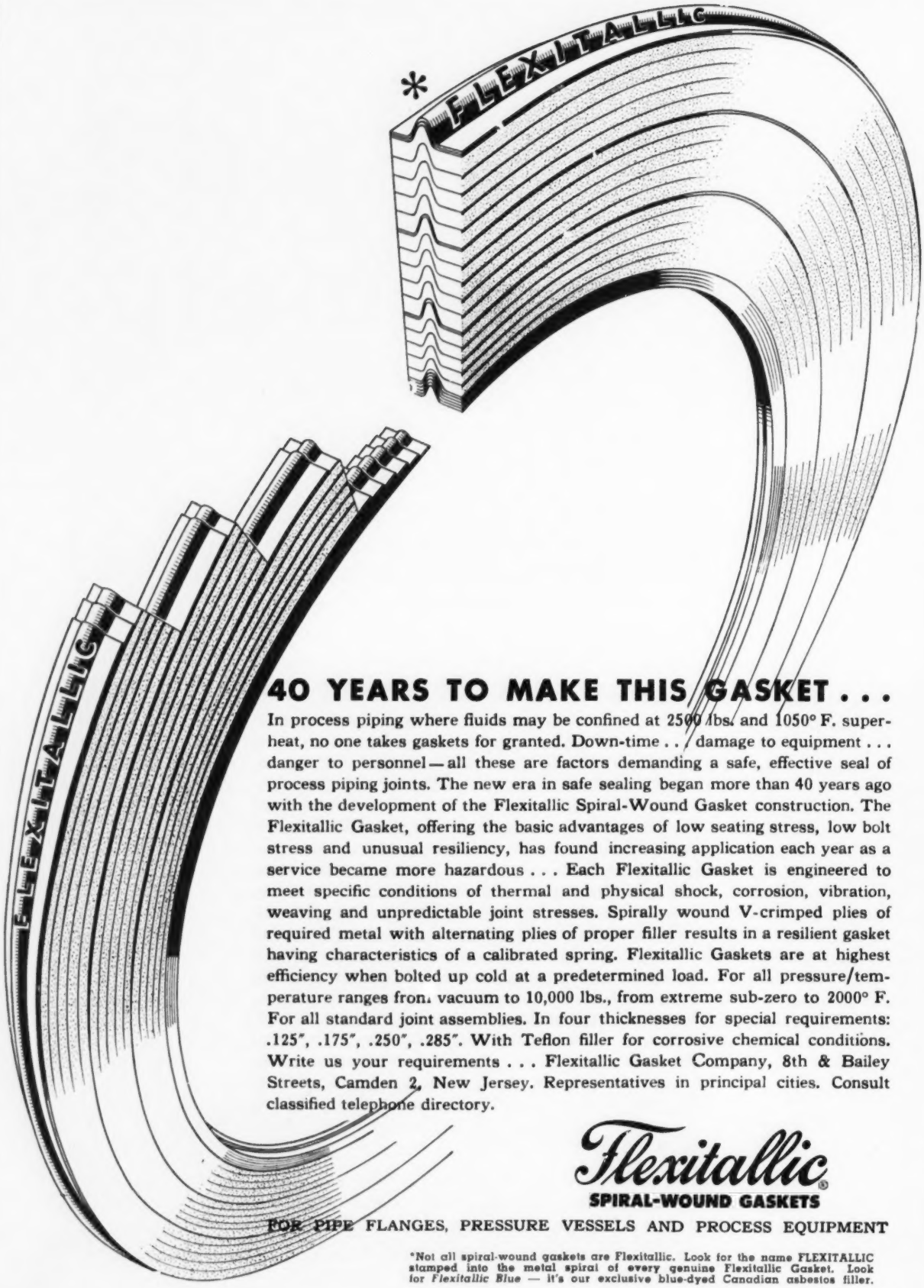
Oxalic
Acid
and storage.



5 ROTARY DRYER removes moisture from oxalic acid.



4 CENTRIFUGES (rubber-lined) filter oxalic acid.



40 YEARS TO MAKE THIS GASKET . . .

In process piping where fluids may be confined at 2500 lbs. and 1050° F. superheat, no one takes gaskets for granted. Down-time . . . damage to equipment . . . danger to personnel—all these are factors demanding a safe, effective seal of process piping joints. The new era in safe sealing began more than 40 years ago with the development of the Flexitallic Spiral-Wound Gasket construction. The Flexitallic Gasket, offering the basic advantages of low seating stress, low bolt stress and unusual resiliency, has found increasing application each year as a service became more hazardous . . . Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

SAFE CONTROL

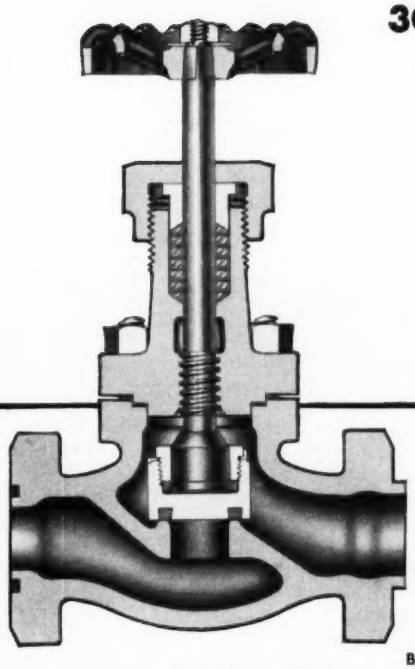
for ammonia and other hard-to-handle fluids

CRANE

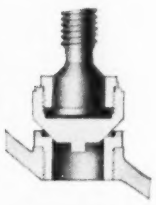
300-pound heavy-duty all-iron valves

Put these Crane valves to the test—use them for ammonia, air, oil, gas, caustic solutions, chlorinated compounds, alcohols—for chemicals and process work. Their rugged bodies of Ferrosteel (35% stronger than cast iron)... their precision seating designs... the unusually deep stuffing box and high-grade packing... the sweeping interior body contours... assure the safety and lasting service you want.

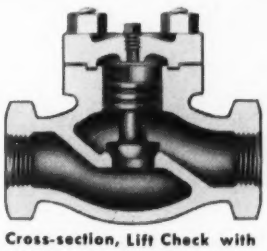
The line includes *bolted bonnet* globes and angles with choice of disc, *union bonnet* globes and angles with plug-type disc, lift checks, expansion valves, relief valves, liquid gauges—and all the fittings, flanges, return bends and other specialties for a complete Crane Quality installation. Check with your Crane man.



Cross-section bolted bonnet Globe, with flanged ends and special lead-faced disc. Sizes ¼ to 4-inch.



Bolted bonnet Globes also available with steel disc and seat where high temperatures or corrosion prohibit use of lead.



Cross-section, Lift Check with bolted cap, and cushioned disc action which increases valve life. Sizes ½ to 2-inch.

New 6-page folder AD1977 catalogs this complete Crane line. Write direct, or ask your Crane Representative.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

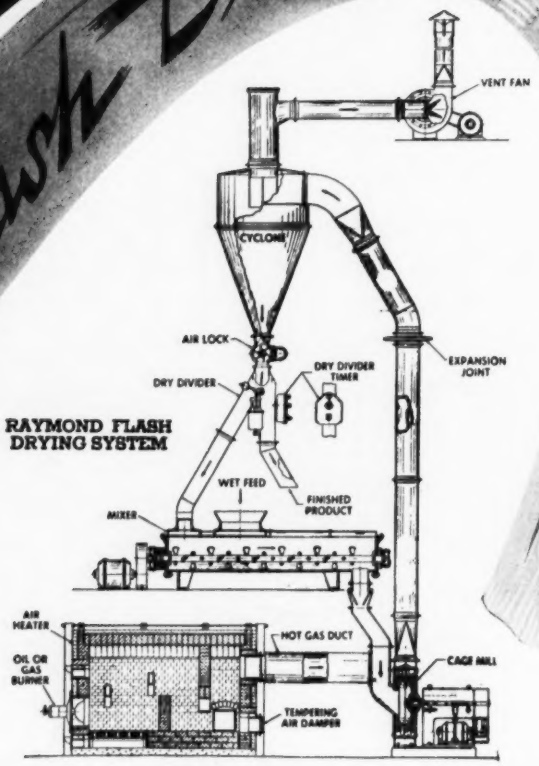
CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

New *Simplified Process for reducing*

DI-CALCIUM PHOSPHATE to a fine dry DUST-FREE PRODUCT

RAYMOND Flash Drying



The removal of definite amounts of surface moisture from Di-Calcium Phosphate without disturbing the chemically combined moisture is a problem easily and economically solved by the Raymond Cage Mill Flash Drying System.

The raw material carries initial moisture of 35% to 40%. This is removed in the Cage Mill Flash Drying operation to 3% or less with retention of just enough moisture to provide a relatively dust-free product.

Comparatively high inlet temperatures are used to insure fast drying action while the material is disintegrated in the Cage Mill to a fine, dry, uniform powder.

Raymond Flash Drying may also be used to extract any desired part of the chemically combined moisture from Di-Calcium Phosphate or similar products. It may be utilized for the safe drying of heat-sensitive materials without detriment to the finished product.

Flash Drying is applicable to such materials as chemicals, pigments, industrial wastes, filter-press products and various other materials for simultaneous drying and disintegration to powdered form.

For details and applications write for Flash Drying catalog No. 54A

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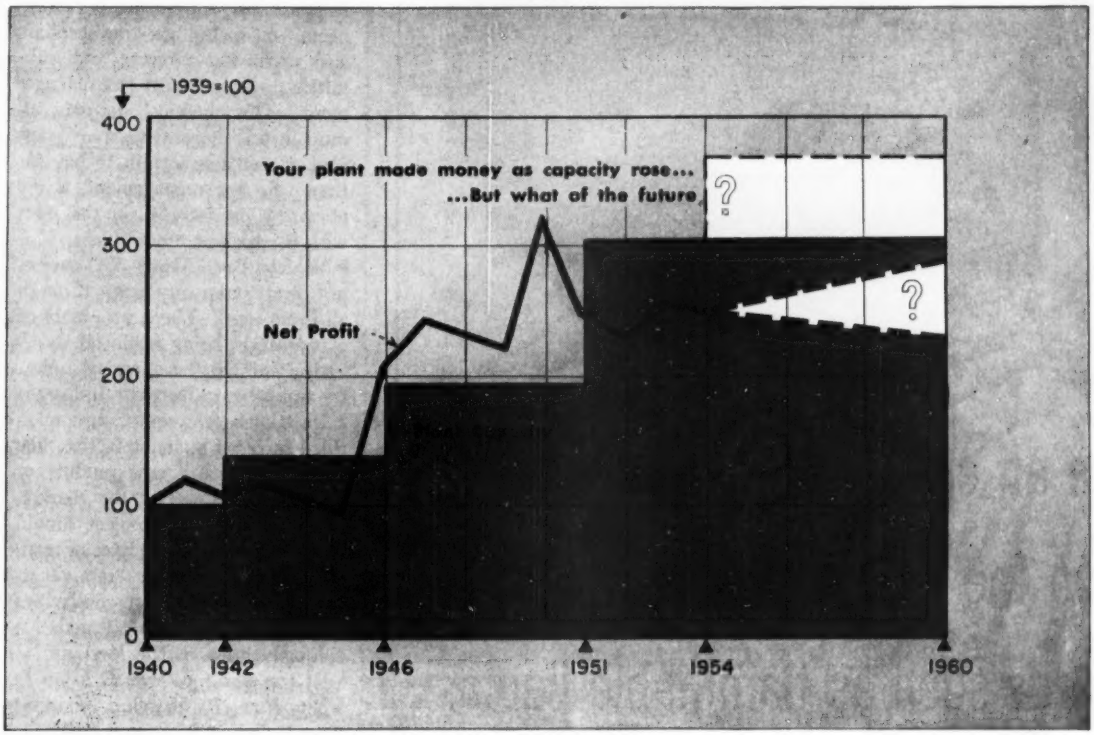

When Does It Really Pay You to Expand?

When you can make a good profit, of course. But you've got to call your shots a lot closer in the next few years than you have since the war, so be ready.

ROBERT P. ULIN

For a lot of chemical companies, 1954 is going to be the year when people first began to ask questions about expansion. Do we really need this expansion? Will it pay?

When the whole economy was expanding, with its annual dose of inflation, there didn't seem to be much point to these questions. If a project was soundly engineered, it probably would pay handsomely. At least that was normal thinking.

But in today's highly competitive situation, production managers are finding more of their ideas blue-penciled by the financial men.

The basic idea is that chemical plants are not set up just to decorate the skyline or to keep their chemical materials in a state of reaction. They're supposed to make money. And to ensure that they do, most large companies find that they have to budget capital expenditures pretty carefully.

As Horace G. Hill, formerly budget director of Atlantic Refining, explains (a bit wryly): "The capital expenditure budget is one of the tools which management employs to protect the stockholder against the natural inclination of his hired servants to spend his money for him in lavish or foolish ways."

▶**The Engineer's Job**—What this means is that the chemical engineer has to justify his ideas in financial as well as engineering terms. It's the engineer who starts most projects that eventually wind up in the company's capital expenditure program. The plant engineer is responsible for his equipment. So he is the man who should study the economics of replacements and recommend new equipment when it will be profitable.

Similarly, those who work on new products need more than a forecast of new markets. They should come up with something on the costs of production, the size of investment involved and a rough estimate of profits. *(Continued)*

BOB ULIN *is senior member of McGraw-Hill's Economics Dept. and specializes in finance and capital investment problems.*

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ECONOMICS . . .

In most large companies, the head of a production division has responsibility for sorting out engineers' estimates on replacement and expansion projects and submitting a program to top management. The chemical industry almost invariably turns up more good ideas than there is cash to pay for them. So top management, if it's operating precisely, picks the ones with the highest profit-tags.

▶ **Which Pays Most?**—Of course, not every company goes through all these steps. There are plenty of expenditures being made off somebody's cuff, in the chemical industry and other industries. And profit calculations are sometimes overruled by other strategic factors, like being first with a new product or protecting a share of the market.

But ideally every project should be considered, at each layer of management, in terms of "rate of return"—the profit per dollar of investment. That's what makes a company grow in the long run.

If you don't believe it, listen to what Earl J. Wipfler, assistant comptroller of Monsanto, told the American Management Association:

"The investment of large sums in new products or processes without adequate appraisal of the relationship of prospective earnings to the required investment could mean the difference between success and failure." So Monsanto's management considers each project in terms of return on the investment, although "where it is desirable to produce a raw material rather than depend on an outside source, we may be satisfied with a lower rate of return than would be the case for a new product."

If management sets these standards, the chemical engineer will need some guidance in computing profit potentials. What's the right way to figure the rate of profit on a new project? Here are the methods that seem to be in widest use:

▶ **The Pay-Back Method**—Almost everyone uses this as a rule-of-thumb in considering new equipment. How soon will the cash earnings from installing the equipment—usually the labor saved—pay back the cash outlay?

If it would take one year, a project is obviously worth considering. And if it takes 20 years, it obviously isn't—at least in the chemical process industries.

This is a workable method for screening out very bad projects, or calling attention to very good ones. But it's not precise enough to use in comparing the merits of a number of seemingly attractive projects, as top financial management must do. It doesn't show what the rate of return would be over a longer period (often less), nor does it take into account such things as taxes, interest and salvage value.

▶ **Return on Gross Investment**—This method figures the average annual profit on a project over its useful life—before taxes, that is. Several leading chemical companies use it.

Estimates of sales and profits are carefully made to take prices and cost trends into account. Average profit is then compared with gross investment—the sum of new plant expenditures, old plant materials used in the project and additional working capital required. A $1 million annual profit on a $5 million investment equals 20 percent rate of return.

▶ **The Investor's Method**—This is the system recommended last year by Atlantic's Mr. Hill to the National Society for Business Budgeting. Its advantage is that it allows for interest on money in proportion to the length of time it's tied up. Disadvantage: it's complicated. Here are the details:

- List the capital expenditures, for replacement or expansion, year by year to the completion of the project.
- Add on routine replacement expenditures and operating expenses for each year of the project's useful life.
- Total these expenses and subtract the total from each year's estimated receipts. Add up the grand total for the life of the project. This is the estimated total profit before taxes.
- Using a compound interest table, find the interest rate that would produce total interest over the life of the project equal to its

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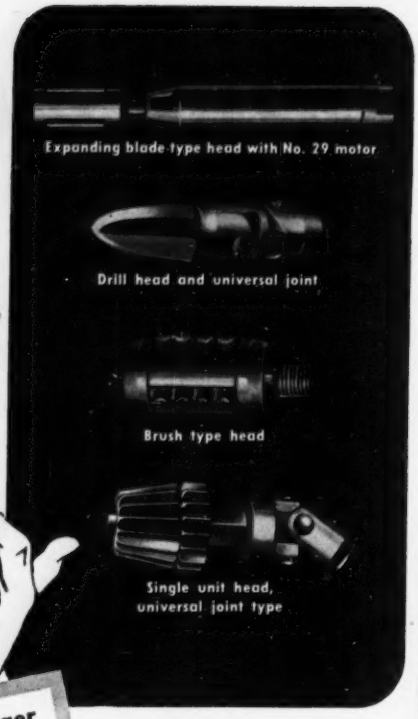
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ECONOMICS . . .

total profits. This is the "rate of return" on the project, the best measure of how well it would pay. Here's an example:

Rate of Return of Expansion Project

Time, Years	Annual Profit, Gross	Profit After 25% Interest*
Carryover on Old Capacity	—25	—25
0-1	—20	—17
1-2	...	...
2-3	15	8
3-4	30	13
4-5	15	5
5-10	80	13
10-15	60	3
15-20	40	...
20-25	10	...
Total	205	...

*Cumulative on new investment

This indicates that the project could afford to pay interest as high as 25 percent, continuously compounded, on the total obligation originally assumed or subsequently incurred and could repay the entire amount during the life of the project. On this basis the project is classed as capable of earning a 25 percent return. Both total profit and the estimated rate of return can be modified, if appropriate, by adjustment for general company overhead and federal income taxes. The rate of return puts a profit-tag on the project that top management can look at and compare with other projects from other divisions of the company.

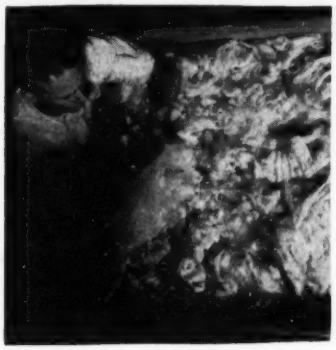
If all this sounds complicated, remember that the financial people still have a lot of pencil work to do after they get a list of projects and their rates of return.

What is the minimum rate of return they should accept? It should be at least as good as the average the company has been getting on its retained earnings in past years. But if outside funds have to be raised, there's another problem: how much interest does the market demand?

If you think the budget department demands high returns, take a look at the stock market page and compare the price of your company's common stock with the dividend. That'll show you how much return the investor wants—and it may be a shock.

Although the chemical industry has been somewhat favored in this respect, most industrial stocks pay close to 6 percent dividend yield.

And a company that's expanding can seldom pay out more than 40 percent of its earnings as dividends. So it has to earn about 15 percent (after taxes) on new investments.



Textile Future Good Despite Slowdown Now

Total U. S. consumption of textile fibers will be at least 70 percent greater in 1975 than it is today, notwithstanding talk of current overproduction. This reassurring forecast by Willard C. Wheeler* was made in a recent report to the industry-sponsored Textiles Seminar of Columbia University.

The report also reached these other conclusions:

- While the poundage of cotton will increase, its percentage of the total should decline to about 50 percent.
- If growers don't prevent it and wool regains its historic percentage position, wool poundage will more than double. Wool will be helped by scientific advances in blending with both natural and man-made fibers and in shrinkage control and other finishes which will broaden both consumer and industrial end-uses.
- If growers respond to their opportunity, silk can regain at least half of its historic percentage position and reach a volume 15 times as great as today. Blends may play an important part in this development, too.
- There is no visible reason why rayon and acetate should not main-

*Marketing and business economics consultant for Anderson & Cairns, Inc., advertising agency, New York 22, N. Y.

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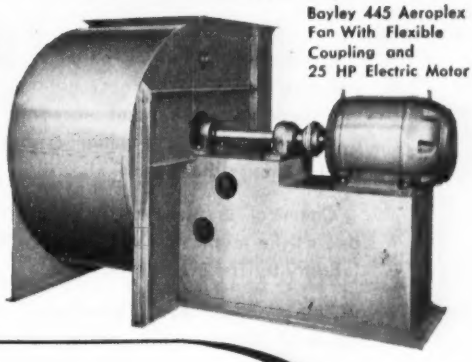

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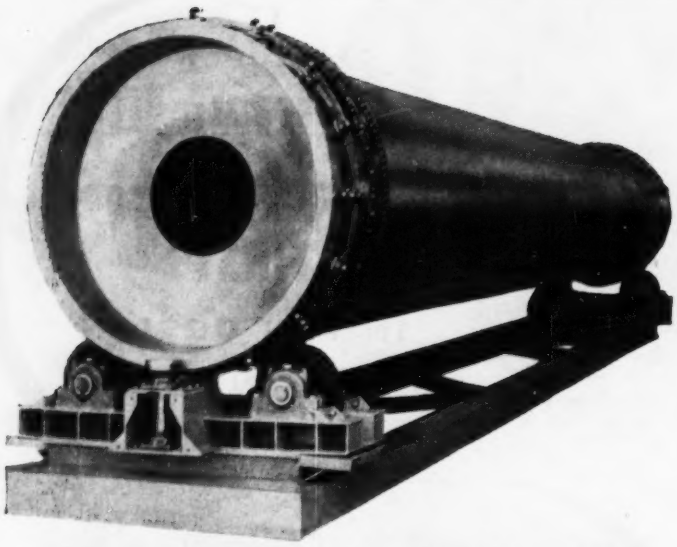

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tain and even improve their percentage position and achieve a poundage 80 percent greater than today.

• The other and newer man-made fibers have passed their period of testing. They have reached the point of popular demand and are just entering a period of assured dynamic growth. Given the necessary capital and aggressive promotion, they should reach the percentage position now occupied by rayon and acetate, increasing their poundage by eight times.

• In 1952, mills spend 90 percent as much for man-made fibers as for cotton. They spend more for rayon and acetate than for wool and almost as much for the newer synthetic fibers as for wool.

On the price side, Wheeler says: "Cotton is no longer the only fiber in the low-priced field and one may run little risk in forecasting that rayon and acetate rather than government action will eventually set the market price for cotton."

Also: "The newer synthetics have declined in relative price faster than either rayon or acetate in their first twelve years and there can be little doubt that the long-term direction will continue downward. It is not inconceivable that the man-made fibers, excepting nylon, will work down to the average fiber price level."

Soviet Chemical Output Continues to Rise

Running just about on schedule, the Soviet Union has announced record high chemical production in 1953. According to the USSR's Central Statistical Administration, Russia's chemical plants achieved 102 percent of their over-all goals last year. This was slightly better than the 101 percent of plan reported for Soviet industry as a whole.

As is true in most iron curtain countries, the emphasis has been on agricultural chemicals. Mineral fertilizer output went up 9 percent in 1953, insecticides 43 percent. Future schedules call for annual mineral fertilizer production of

16.5-17.5 million metric tons by 1959, 28-30 million metric tons by 1964. Pesticide producers are being called on to double their output as soon as possible.

Other production gains included: caustic soda 15 percent; calcinated soda 19 percent; synthetic rubber 13 percent; chemical equipment 24 percent. Output of synthetic ammonia, synthetic phenol and dyes also exceeded the government's 1953 plan.

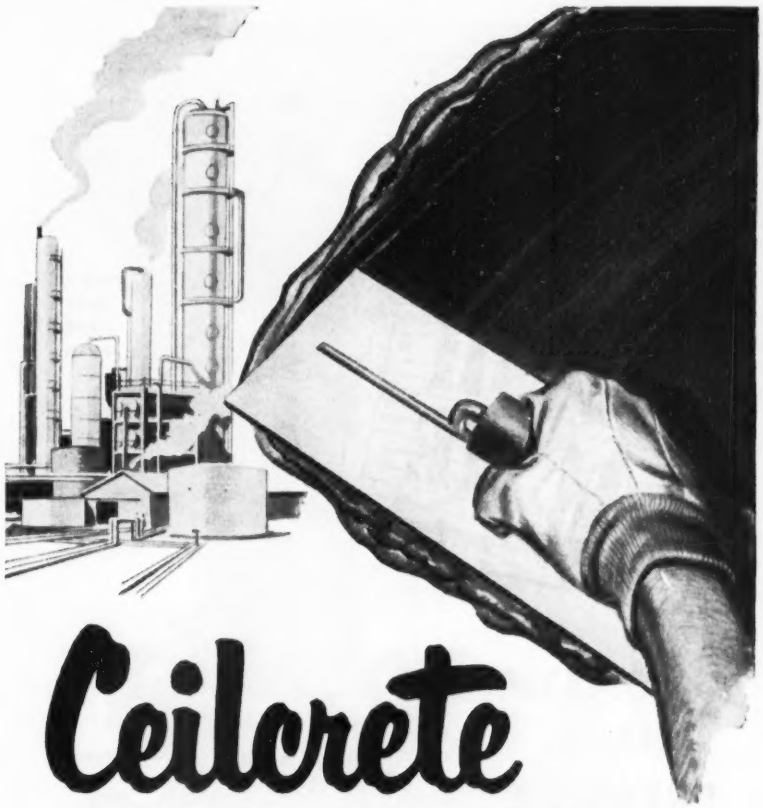
But all is not sweetness and light for the industry. Most production is still inadequate, particularly aids to agriculture. And in discussing the Central Statistical Administration's report, the official newspaper, *Pravda*, complained vigorously that the chemical industry still has a number of lagging plants that did not meet government goals either in quantity or quality.

U. S. Steel's Fairless declares . . .

Private Enterprise Holds Prosperity Key

"Government alone can neither create prosperity nor overcome depression." So said Benjamin Fairless, chairman of U. S. Steel, in a recent address before the 117th annual meeting of the Delaware Chamber of Commerce.

Voicing his approval of the present administration's efforts to maintain a favorable economic climate, Fairless declared that the responsibility for prosperity or recession rests squarely on business and in-



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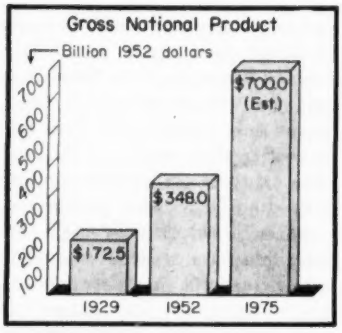
ECONOMICS . . .

dustry. Here's a quick rundown of his major points:

- Talk of a recession is politically inspired by the advocates of "big government" attempting to bring about a change in the federal administration.
- Unemployment has been exaggerated. It is very close to the irreducible minimum and is actually below the average of recent years. Moreover, there are 3.5 million more persons working today than in 1947.
- Plans requiring deficit spending up to $12 billion this year—mostly by administration opponents—would result in another crippling round of inflation.
- The $15 billion current public works projects on the shelf is small compared with the $28 billion spent last year by American business for plant equipment alone. Business expenditures not only create jobs, but provide productive facilities to generate new purchasing power for many years to come.
- It's up to American business to prevent a recession by increasing the country's earning and purchasing power. The past record is conclusive that government cannot prevent a recession.
- Government, though, must do two things if business is to avert a depression: maintain an economic atmosphere that will encourage the flow of private investment; enable American business to operate at peak efficiency by scrapping obsolete equipment even if it is not worn out or fully depreciated.
- There are four other requirements which government should provide: peace for prosperity instead of the boom and bust which war produces; stable currency; competition in a free and open market; maximum possible incentive for all people so that enterprise will not be impaired. Government has met the first three requirements in the last twelve months and is striving to accomplish the fourth.

When government does accomplish the fourth, the future of the country's economy will be exactly what private enterprise makes it. And private enterprise cannot—and will not—deny it.



Gross National Product Will Double by 1975

If America continues her present trends, our gross national product—the total market value of all goods and services—will reach an annual rate of $700 billion by 1975—double today's figure.

In making this projection, the National Association of Manufacturers also estimates that this will require additional capital investment of $275 billion. And taxes, says NAM, are a serious roadblock to this needed expansion.

Business in 1954 Will Pass Most Expectations

Can a community which has all the basic economic elements needed to sustain a high level of prosperity be scared into a serious recession or depression? The McGraw-Hill Economics Dept. doesn't think so and here's why:

Right now business in general is very good, by any comparison except with the superboom of last year. And unless we somehow succeed in talking ourself out of it, that's the prospect for the months ahead.

But unlike most postwar years, new successive highs are not in the cards. Instead, there will be some continuation of the decline already in progress. And it's apparent that ready to pounce on every news of decline as an omen of disaster will be some Democrat or major labor leader, intent on putting the Eisenhower Administration out of business at the polls.

And who knows, perhaps in the last analysis this will prove a good thing. Otherwise, it's not incon-

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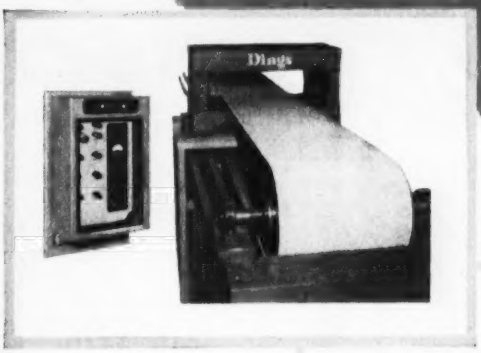

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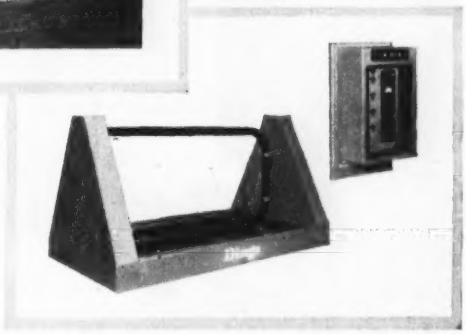

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ceivable that a speculative boom could get underway by next fall.

▶**Some Elements Here Now**—If it gets past the politicians, business is not only going to be good but far better than many people have been led to expect. Business profits, freed from the excess profits tax, promise to be relatively high. So there you have at least two major ingredients of a speculative boom which historically has almost always topped off a major wave of prosperity such as we have been enjoying.

The other ingredients of such a boom are not apparent, however, primarily because we are so well fixed with productive capacity. That's going to keep most goods in adequate supply and hold down prices. Also, a fairly full budget of cheerless economic news, vigorously exploited by the "outs," will probably put an effective damper on the essential whoopla ingredient of a speculative spree.

That we have what it takes in the way of basic economic elements to sustain a high level of prosperity is made clear by a closer look at the main streams of expenditure which converge to create prosperity—or something else. These are spending by consumers, government and business, plus the relatively minor flows of imports and exports.

▶**Awesome Figures for '53**—Here, roughly, is how the three major types of expenditures stacked up last year:

- Government spending for goods and services—federal, state and local—came to $83 billion, about two-thirds of it for military.
- Business invested about $28 billion—a new record—to improve and expand its plants and equipment. Business also added about $4 billion to its inventories.
- Consumers spent about $242 billion. Among the impressive things they bought were about 5.8 million automobiles, 6.5 million television sets, more than a million room air conditioners and 1.1 million new homes.

Together these figures add up to the biggest year in the history of the American economy—or any economy, for that matter.

▶**For 1954**—It is already clear that government expenditures will again be very large. The Federal budget implies spending about $54 billion for goods and services in calendar 1954. That's about $4 billion less than last year. But state and local government spending will go up by at least $2 billion. So the total drop in government expenditures will be about $2 billion.

Substantial cuts in Federal taxes will allow consumers and business to up their spending enough to offset the small drop in government spending. Taxes have already been cut by about $5 billion, less $1.2 billion of increased social security taxes, and more cuts are on the way.

Business expenditures will also be very high in the months immediately ahead. Official estimates show that business plans to invest at an annual rate of about $28 billion in new plants and facilities in the first quarter. Even if this rate drops, the year as a whole may average only $1-2 billion under 1953.

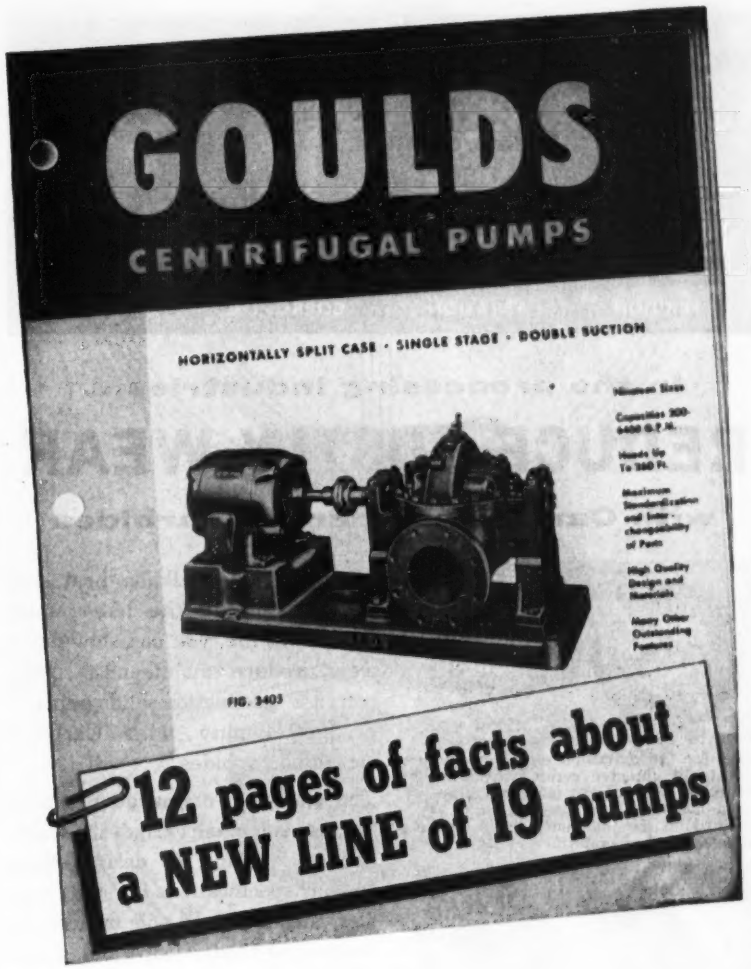
As for consumers, they will have the financial capacity to spend at least as much this year as they did last year. Partly because of Federal tax cuts, consumer incomes are higher now than they were at this time last year.

And the $1 billion, two-year expansion program just announced by General Motors is at least one indication that preliminary plans for manufacturing industries are going to be carried forward rather than cut back.

▶**How Easily Do We Scare?**—The key question about the consumer does not show up in appraisals of his financial status. It's not, "has he got the money?" but "will he spend it?" One force operating to discourage consumer spending will be the operations of the prophets of doom mentioned earlier.

There are those who argue that this sort of thing will be more effective than ever before precisely because consumers are so well heeled that they can afford to cut their spending.

It's been estimated that 40 percent or more of consumer spending


GOULDS
CENTRIFUGAL PUMPS
HORIZONTALLY SPLIT CASE · SINGLE STAGE · DOUBLE SUCTION
FIG. 3403
12 pages of facts about
a NEW LINE of 19 pumps

The quickest way you can really discover what the new Goulds Fig. 3405 centrifugal pump can do for you is to read the descriptive bulletin pictured above.

Here are some hints of what you'll find:

The quality of materials and extras of design that you have been able to get only by paying extra are *standard* on this new pump: stuffing box bushings, stainless steel impeller keys, Teflon water seal rings —to mention a few.

The Fig. 3405 carries interchangeability of parts far beyond anything we've been able to do before. Only three shaft and rotating parts assemblies (exclusive of impellers and wearing rings) provide for 19 pump sizes.

This means real spare parts inventory savings for any plant that uses many pumps. It also means easy-to-make field changes to meet new requirements.

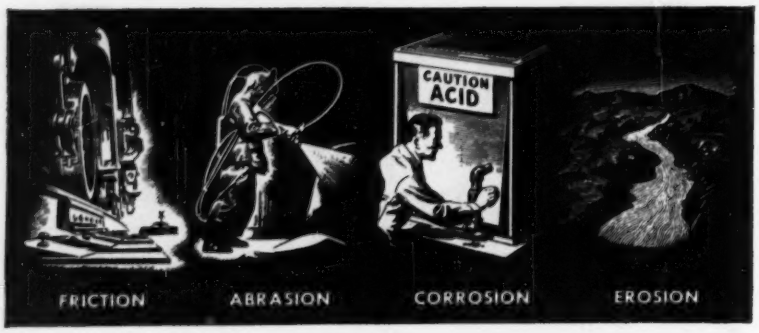
We've come as close as modern design and materials allow to putting into this new pump what our industrial customers have told us they want. The 12-page illustrated bulletin tells you all about it. We'll be glad to send you a copy.

To get a copy of Bulletin 721.6, get in touch with the nearest Goulds representative or just fill in the coupon, pin it to your letterhead and mail it to us at your convenience.

GOULDS PUMPS INC.
Seneca Falls New York

GOULDS PUMPS, INC.
Dept. CE, Seneca Falls, N.Y.
Please send me 12-page information Bulletin No. 721.6 on the new Fig. 3405 centrifugal pump.

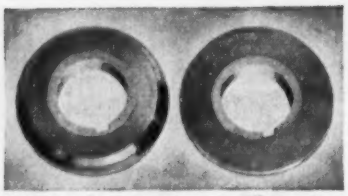
Name_____
Company_____
Street_____
City_____ Zone____ State____



In the processing industries...

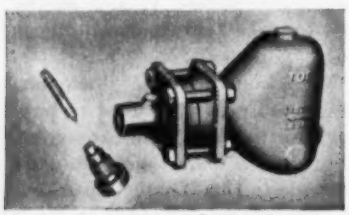
REDUCE COSTLY WEAR

with Carboloy® cemented carbides



Dies for the extrusion or pill pressing of highly abrasive ceramics, pharmaceuticals or powdered metals, equipped with Carboloy cemented carbide, remained on the job many times longer than any other material.

In one plant, steel spray nozzles for homogenizing and dehydrating food products lasted 100 hours, due to the corrosive-abrasive action of the food products. Then Carboloy cemented carbide nozzles were used, and nozzle life increased to 3000 hours.



Steel valve stems and seats in a refrigerator regulating valve were quickly corroded and worn by ammonia. To resist this, inserts of Carboloy cemented carbide were substituted. Valve life increased 5 to 6 times.

Where acids, alkalis, heat, oxidation and the like reduce equipment life, you can slow down wear, reduce maintenance costs, increase production and improve product quality with Carboloy cemented carbides.

The Carboloy organization manufactures cemented carbides in standard stock items, or designs them to your specifications for spray nozzles, steam valves and orifices for processing foods, soaps and drugs. Plus countless other applications such as core pins for ceramic baking where friction, corrosion, erosion and abrasion must be resisted.

Ask your equipment manufacturer, or write us, about strategic parts made wear-resistant through use of Carboloy cemented carbides.

Put These Outstanding Characteristics To Work In *Your* Plant:

- High abrasion resistance
- High corrosion resistance
- High erosion resistance
- High heat resistance
- High impact strength
- High friction-wear resistance
- Nonmagnetic
- Light weight (where desired)

CARBOLOY
DEPARTMENT OF GENERAL ELECTRIC COMPANY
11165 E. 8 Mile Blvd., Detroit 32, Michigan

"Carboloy" is the trademark for products of the Carboloy Department of General Electric Company

SETTING THE PACE FOR INDUSTRIAL PROGRESS

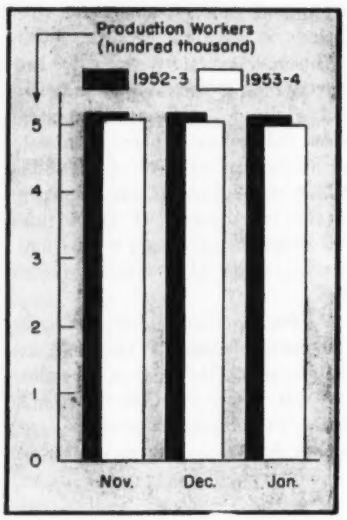
ECONOMICS . . .

is now for "optional" items, like cars and appliances. The idea is that it won't take nearly so much pressure to discourage buying as it would if all consumer spending were for necessities.

▶ **Inventories Still With Us**—If consumers (or businessmen) should take fright and cut their spending, the effect on production would appear very quickly. The reason is the somewhat swollen state of business inventories—now more than $81 billion.

Business has been busily engaged

HIGHLIGHT OF THE MONTH



Good Outlook for Chemical Employment

Chemical firms are swinging into the initial months of 1954 with a level of employment that is only 3.2 percent below last year. The number of production workers reported by chemical firms has been slipping slightly since September of 1953.

For the past several years chemical employment has turned up during the first quarter of the year; however, now that these figures are trending downward for all industries, the chemical figures may simply level off. The decline for chemical employment has not been as steep as the declines shown for most other non-durable goods industries.

in trying to reduce its stocks by cutting production. It has succeeded in halting the sharp rise that took place last fall. But a drop in sales could make inventories look a lot larger, bringing a further production cut. The change from inventory accumulating to inventory cutting could thus be the biggest change in the outlook from 1953 to 1954.

The next few months will add substantially to this picture of the economy in 1954. For one thing, we will have a chance to see if the consumer and businessman remain steady, as we expect they will, in the face of a rising chorus of dire economic predictions.

In the meantime, we will have to live with the information we have. And it points to another very good year for the economy in 1954.

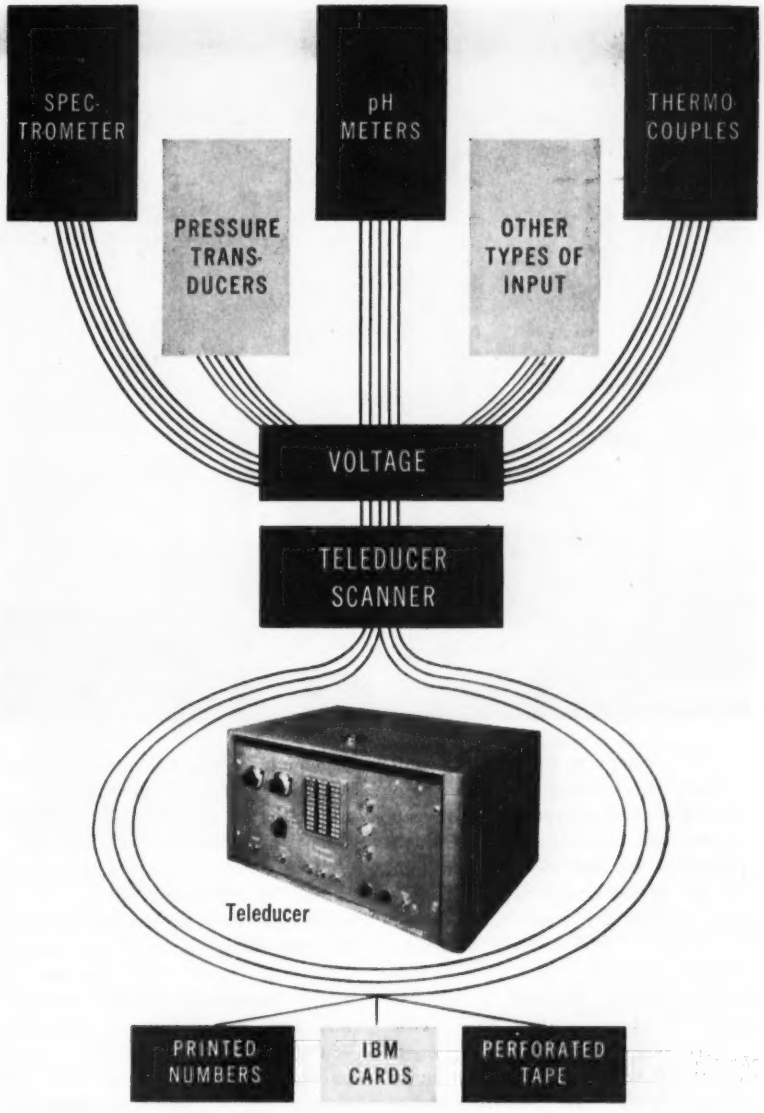
NOTE: *Watch for the results of McGraw-Hill's seventh annual survey of business plans for capital investment in the next issue of* Chemical Engineering.—EDITOR.

Economic Briefs

U. S. primary magnesium production in 1953 amounted to 93,075 short tons, about 12 percent less than in 1952. Dow's Freeport, Tex., plant accounted for 32 percent. The rest came from six government-owned plants, five of which suspended operations as of June 30, 1953. Total consumption of magnesium was 38,000 tons, 15 percent below 1952. —Source: Magnesium Assn. and U. S. Bureau of Mines.

Annual chemical industry sales may reach $16 billion by 1960, according to F. H. Good, Stanford Research Institute economist. This contrasts to a 1952 total of $8 billion.

Margarine production in 1953 was 1,291,803,000 lb. marking the fourth successive record year, says the National Assn. of Margarine Manufacturers. Consumption was 1,165,000,000 lb., 90 percent of which was the yellow type.



Automatic scanner and digital recorder...

The new Teleducer Scanning System eliminates high labor costs and human errors from scanning and recording. It gives you accuracy of 0.1%, speeds as fast as one recording operation per second, and readout in decimal numbers.

One Teleducer Scanning System handles from one to 100 channels of input from various sources, reads out in printed numbers, punched cards or perforated tape.

Scanning and recording can be continuous or intermittent, depending on your need.

Specifications will be sent you upon request. Please address inquiries to Preston W. Simms, Dept. CE-4.

TELECOMPUTING CORPORATION

BURBANK, CALIFORNIA • Washington, D. C.

The extent to which metal will corrode in atmosphere — or even whether it will corrode at all to any appreciable degree — is determined primarily by the moisture content of air. While deterioration at normal temperatures and humidities of less than 35% is so slow as to be almost negligible, the rate accelerates rapidly beyond a critical point of approximately 65%. This activity is intensified when such contaminants as hydrogen sulfide or sulfur dioxide are absorbed from industrial atmospheres. Impingement of solids, which tends to hold this acid film in contact with metal, localizes and further advances corrosive attack.

When exposure to atmosphere includes also exposure to sunlight and to the variables of weather, the situation becomes more complex. Such factors as the composition of metal and of the protective rust film that forms upon it, the length of time surfaces are wet, the extent to which they retain moisture, and whether they may be bared intermittently by heavy rainfall are influential in determining metal life.

An understanding of the mechanism of corrosion in all of its varied phases is an obvious requisite to prescribing methods of control. Thirty-five years' study and evaluation of industrial corrosion problems and the formulation of protective coatings to meet them has taught us something about corrosion and the ways in which it may be checked successfully.

We are ready to share that knowledge with you in an analysis of any metal-maintenance problem you feel requires the *different* approach of considered engineering judgment . . . to give you a recommendation you can be sure is technically correct and practically workable — for quality protective surfacing that is right for you because it is individually job-selected to meet your service specifications.

MAINTENANCE FOR METAL

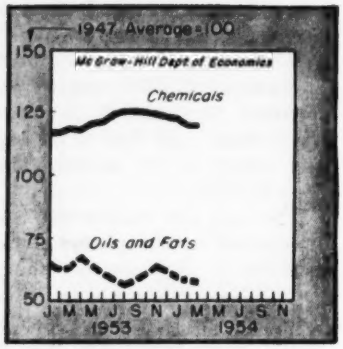
THE DAMPNEY COMPANY

160-1 HYDE PARK, BOSTON 36, MASSACHUSETTS

THIS MONTH'S

Industry

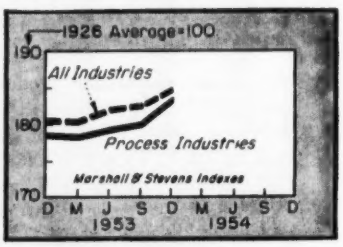
PRICES . . .



CHEMICAL PRICES 123.6
OILS & FATS PRICES 59.6

	Chemicals	Oils & Fats
As of Mar. 1, 1954	123.57	59.64
Last month	123.57	61.28
1 year ago	119.07	63.71
2 years ago	120.71	61.23

EQUIPMENT COSTS . . .



ALL INDUSTRY AVERAGE 184.8
PROCESS INDUSTRY AVERAGE . . 183.5

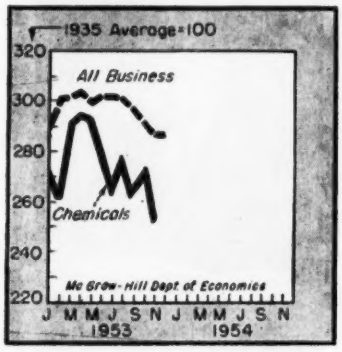
Process Industries	Sept. 1953	Dec. 1953
Cement mfg.	174.3	177.8
Chemical	182.7	186.4
Clay products	169.2	172.6
Glass mfg.	172.7	176.2
Paint mfg.	176.0	179.5
Paper mfg.	176.3	179.8
Petroleum ind.	179.4	183.0
Rubber ind.	181.8	185.4
Related Industries		
Elec. power equip. .	184.6	188.3
Mining, milling	183.7	187.4
Refrigerating	203.1	204.9
Steam power	172.3	175.7

Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. See *Chem-Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1954, pp. 214-5 for annual averages since 1913.

Trends

Douglas Greenwald

CONSUMPTION...

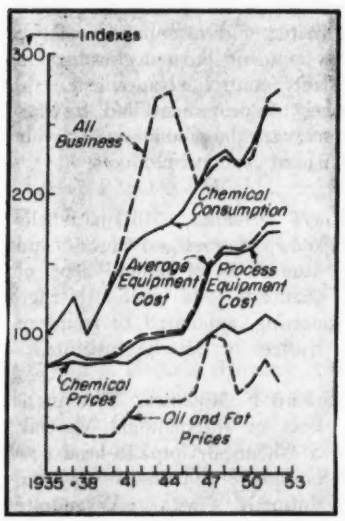


BUSINESS ACTIVITY (Dec.)...287.2

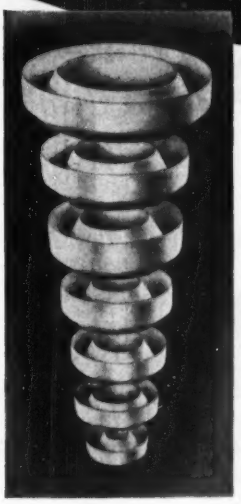
CHEMICAL CONSUMPTION

	Dec. (Prelim.)	Nov. (Rev.)
INDEX	**249.4**	**253.4**
Fertilizer	56.08	52.67
Pulp & paper	28.60	30.98
Petroleum ref.	28.22	27.26
Iron & steel	14.57	15.94
Rayon	24.65	23.73
Glass	20.46	22.00
Paint & varnish	22.27	23.70
Textiles	9.79	10.05
Coal products	11.41	11.47
Leather	3.69	3.74
Explosives	7.93	9.10
Rubber	5.29	5.43
Plastics	16.46	17.37

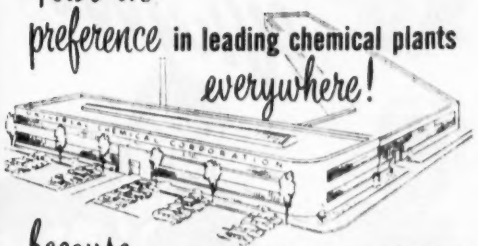
LONG TERM...



"JOHN CRANE"
TEFLON*
"C-V" rings



First in preference in leading chemical plants everywhere!

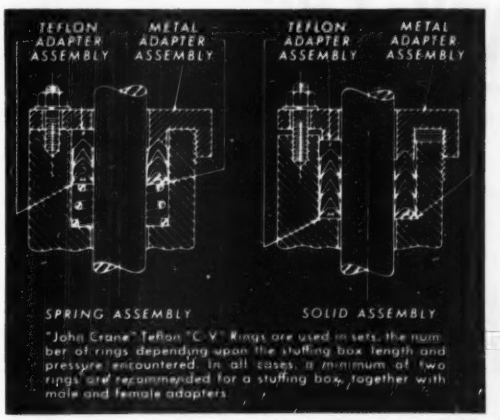


because... Teflon "C-V" Rings withstand

1. Temperature from —94° F. to +482° F.
2. Any corrosive liquid or gas

Why repack with ordinary materials when corrosively inert "John Crane" Teflon "C-V" Rings will effectively seal any hydraulic fluid, including the newly developed synthetics, and resist high temperatures as well. Also, they have extremely low friction characteristics—will not shrink, swell, harden, dissolve, corrode or deteriorate. Ideal for use on all valve stems and reciprocating pumps as well as many centrifugal and rotary pump applications. Cross-section design allows effective sealing at finger-tight gland pressure.

"John Crane" has developed a complete line of standard size Teflon "C-V" Rings and male and female adapter rings to meet practically every need. If you have special requirements, "John Crane" can mold additional sizes to fit your stuffing box requirements.


TEFLON ADAPTER ASSEMBLY
METAL ADAPTER ASSEMBLY
TEFLON ADAPTER ASSEMBLY
METAL ADAPTER ASSEMBLY
SPRING ASSEMBLY
SOLID ASSEMBLY
"John Crane" Teflon "C-V" Rings are used in sets, the number of rings depending upon the stuffing box length and pressure encountered. In all cases, a minimum of two rings are recommended for a stuffing box, together with male and female adapters.

Send for complete information, including this illustrated technical booklet, "The Best in Teflon." Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, Ill.
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

* Du Pont trademark

JOHN CRANE
CRANE PACKING COMPANY

Why Worry?
Why worry about selecting the most efficient pump for the job? A Deming Distributor is within easy reach of your plant. He has what it takes to help you select the right type, size and capacity of pump for any one or more of your pumping needs. If you don't know where to locate Deming Distributors in your area, ask us.
THE DEMING COMPANY
525 BROADWAY • SALEM, OHIO
DEMING PUMPS
DEMING

THIS MONTH'S

Names in

David E. Pierce

Nationally known chemical engineer, author and lecturer, Dr. Pierce has been appointed to the newly-created position of director of manufacturing control at Diamond Alkali Co.'s national headquarters in Cleveland. Identified with chemical processing during his entire career, he brings to Diamond a broad background of specialized knowledge and experience acquired in various engineering-management and plant-supervisory capacities with certain other chemical firms. Dr. Pierce will direct his attention primarily to problems involving the appraisal and analysis of current manufacturing operations at Diamond's 14 plants throughout the country. He is responsible in this connection for coordinating these activities and formulating relative development programs leading to quality control advancement, efficiency improvement and cost reduction in the production of a wide range of chemical products.

Roger Adams. Internationally known chemist and educator and head of U. of Illinois' dept. of chemistry and chemical engineering, appointed to board of trustees of Battelle Institute.

Howard F. Roderick. Vice president of International Minerals & Chemical Corp. to head new phosphate chemicals division. Formerly with Wyandotte

Chemicals. Head of International's phosphate minerals division: **George W. Moyers,** formerly vice president in charge of phosphate division.

A. L. Geisinger. Vice president of Diamond Alkali, to be general manager of company's new plastics division. General manager of company's new chlorinated products division: **C. E. Lyon,** former vice president and works manager of Diamond's Houston plant. His replacement as works manager of Houston plant: **Frank Chrencik,** formerly assistant works manager.

Theodore A. Haschke. Director of sales of newly-organized industrial chemical division of Stauffer Chemical Co., its subsidiaries and associated companies. With company since 1926, most recently as sales manager of eastern division.

Everett C. Gosnell. Chemical engineer, Ohio Machine and Boiler. Formerly with Koppers Co., International Nickel, Lukens Steel, Colonial Iron Works, and Centrifix Corp.

Fred F. Roehll. From national sales manager to vice president in charge of sales, Eutectic Welding Alloys Corp. With company since 1946.

Irvin E. Miller. Superintendent of Standard Oil Co.'s laboratory at the refinery being built in Mandan, N. D. With company since 1944. His successor as group leader at Standard's Sugar Creek, Mo., laboratory: **B. J. Duffy, Jr.,** with company since 1948.

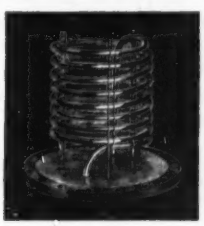
Cortez P. Hackett. Director of development, Solvay Process Division, Allied Chemical & Dye, succeeding **D. O. Yeoman** who retired. Mr. Hackett has been with Solvay since 1923.

Nobody buys
TANTALUM
except
for one reason:
ECONOMY!

Tantalum is *immune* (not merely resistant) to any of the following: hydrochloric acid, bromine, iodine, hydrogen peroxide, nitric acid and perchloric acid. This immunity eliminates, at its source, the many headaches of corrosion—shutdowns, lost production time, repairs, replacements, product contamination or spoilage, fume damage, and a host of other *costly* corrosion results.

In hundreds of installations, tantalum has proven its economy over all other materials used or tested. Because tantalum is immune, light gauge construction is used, eliminating expensive framework and supports. Tantalum, being a metal, is an excellent heat conductor, saving steam or cooling water, permitting closer process controls. Experienced Fansteel engineers can tell you, quickly, whether or not tantalum could help lower your production costs.

Use Tantalum with economy for most acid solutions and corrosive gases or vapors except HF, alkalis, or substances containing free SO_3.



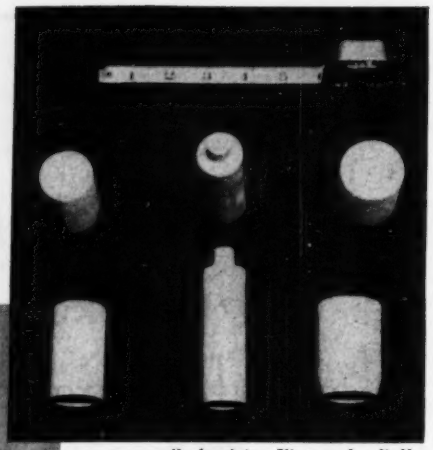
Ask for a copy of our free booklet
"Acid-Proof Tantalum Equipment for Chemical Operations"

FANSTEEL METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS, U.S.A.

3240JC

Small

HIGH ALLOY
CASTINGS

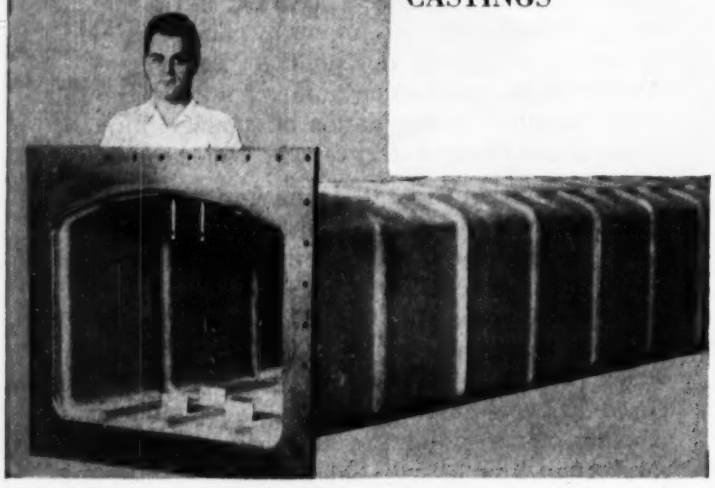


Carburizing Fixture for Ball Bearings 1½" diameter—
Analysis 35% Ni — 15% Cr

DURALOY

Large

HIGH ALLOY
CASTINGS



Muffle for Continuous Strip Annealing
12' 6" long — Analysis 38% Ni — 18% Cr.

LARGE or small DURALOY, can do it! These are just typical examples of the work moving through our foundry. Some of these castings are designed for heat resistance, some for corrosion resistance, some for abrasion resistance; all are cast by experienced foundrymen. All are carefully tested in our up-to-date laboratory.

If you have a high alloy casting problem . . . LARGE or small, we can help you. For more information, send for Bulletin No. 3150-G.

THE DURALOY COMPANY

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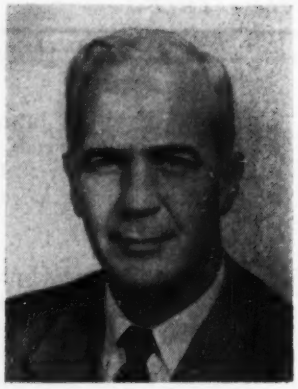
Detroit Office: 2305 Woodward Avenue · Pleasant Ridge, Mich.

Atlanta: J. M. TULL — Chicago: F. D. NELSON — Metal Products Div. — 6 S. Michigan Avenue

METALLURGICAL CONSULTING: Dallas · Houston · Kansas City · New Orleans · St. Louis · Tulsa

NAMES . . .



Herschel H. Cudd

Dr. Cudd resigned as director of the Engineering Experiment Station at Georgia Institute of Technology to become manager of research and development for the American Viscose Corp. In this newly-created position he will be responsible for the research and development activities of the various departments and pilot plants of the company and will have charge of coordinating and planning an expanded research program designed to improve present products and to develop new products.

Raymond C. Firestone and **J. E. Trainer.** Executive vice presidents of Firestone Tire & Rubber. Mr. Firestone was formerly vice president in charge of research and development and Mr. Trainer was vice president in charge of production.

B. M. Downey. From manager of Shell Chemical's plant at Houston, Tex., to manager of manufacturing. Manager of research, development and engineering: **A. W. Fleer,** formerly manufacturing operations manager. Mr. Downey joined Shell in 1925 and Mr. Fleer in 1935.

Carl E. Overton. Vice president in charge of sales, Brad Foote Gear Works. With company since 1948.

William J. Stewart. Chief of protective coatings laboratory, Nuodex Products. Formerly with Sun Chemical. Manager of com-

pany's Elizabeth, N. J., plant: **John Kilcullen,** with company for seven years. Other appointments: **Milton Nowak,** chief chemist, and **Richard Denning,** chief of dispersion section of company's research and development dept.

Wallace L. Howe. Elected a director and vice president in charge of research and development, Norton Co. With company for 30 years.

Harold D. Jolley. Senior vice president and manager of sales, Ceco Steel Products Corp.

Carl O. Tongberg. Coordinator of research and development on products, Standard Oil Development. With company since 1937. His replacement as director of research division of company's Esso Laboratories: **Charles L. Fleming, Jr., with company since 1938.**

William H. Congleton. Technical director of American Research & Development Corp. elected a director of Baird Associates. Vice president for research and development: **Bruce H. Billings,** formerly research director of Baird.

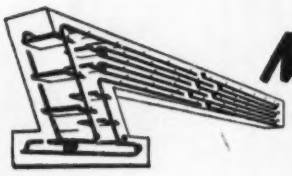
M. N. Gaboury. Plant manager, American Cyanamid's Bound Brook, N. J., plant. With company since 1933. Formerly with Newport Co., Swann Co. and Bakelite.

James P. Beyser. Vice president-general manager of Blaw-Knox's Buflovak Equipment Division. With company since 1926, most recently as works manager. New vice president: **Lambert J. Wischerath,** with company since 1923, most recently as assistant to the general manager.

Alfred T. Loeffler. From assistant vice president to vice president of chemical divisions, Food Machinery and Chemical Corp. Formerly with Hooker Electrochemical and Monsanto.

INVESTIGATE!

GREER



MULTI-TIER METHODS

For over thirty years GREER ENGINEERING has applied the principle of the Multi-Tier Conveyor to many industries whose methods required some form of heating, drying or cooling processes.

RESULTS!

- Streamlined Production
- Valuable Space Savings
- Batch Methods Eliminated
- Labor Costs Cut
- Greater Production at Lower Costs

Competent engineers are prepared to work with you on plant layout and design. *If you have a material handling problem with space limitations, write us for further information. No obligation.*

J. W. GREER COMPANY

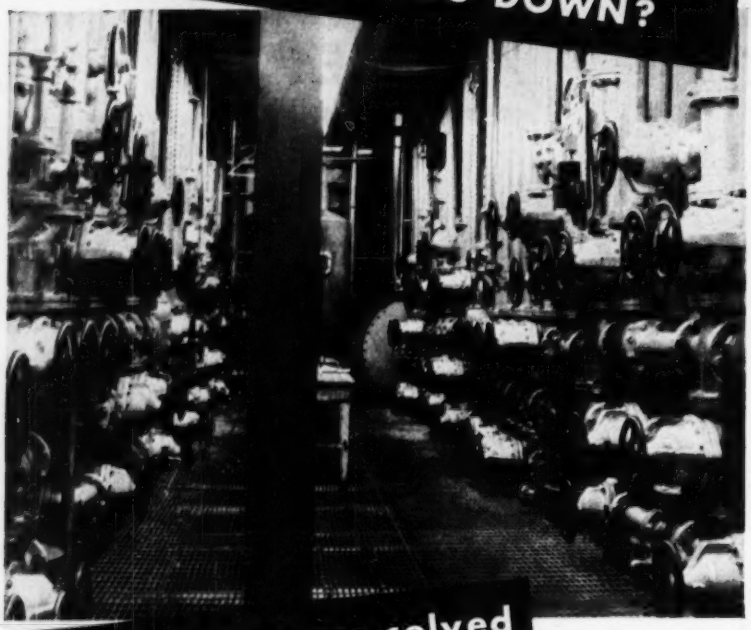
Wilmington, Massachusetts

SALES ENGINEERING OFFICES

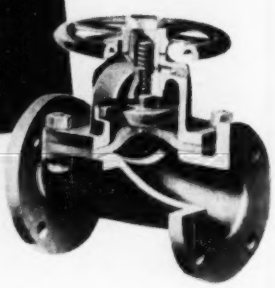
New York, N. Y. Chicago, Ill.

San Francisco, California

VALVE MAINTENANCE COSTS GETTING YOU DOWN?



The problem was solved in this plant with HILLS-McCANNA diaphragm valves



IF YOU HANDLE CORROSIVE FLUIDS THEY'LL DO THE SAME FOR YOU

The unique Saunders Patent design of Hills-McCanna Diaphragm Valves completely isolates the working parts of the valve from the flow. There is no packing to tighten or replace . . . no problem of leakage, internally or externally. You have a choice of body materials of any machinable alloy or linings of lead, glass, rubber, plastic, etc. Fifteen diaphragm materials are available including rubber, Neoprene and Teflon. There is also a wide choice of manual or remote operators. Sizes range from ⅜" through 14". May be used at pressures to 150 psi, temperatures to 350° F.

If you valve corrosive materials write today for descriptive folder. For specific recommendations send an outline of your requirements. HILLS-McCANNA CO., 2341 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

saunders patent diaphragm valves

Also manufacturers of
Chemical Proportioning Pumps • Force-Feed Lubricators
Magnesium Alloy Sand Castings

V-11

NAMES . . .

Lyle C. Jenness

For more than 30 years Professor Jenness, head of the University of Maine's department of chemical engineering, has been devoted to teaching the techniques and principles involved in the production of pulp and paper. He has received the University of Main Pulp and paper Foundation's Honor Award for 1954 "in recognition of his many years of faithful teaching and fruitful research in pulp and paper technology. An inspiring teacher and able engineer, respected and admired by his colleagues and students and highly esteemed by the paper industry."

John C. Hamilton. From production superintendent to general superintendent of Canadian Resins and Chemicals Ltd.'s plants in Shawinigan Falls. With company since 1943. Formerly with Canadian International Paper Co.

J. S. Gilliam. Superintendent of organic dept. at Morgantown, W. Va., plant of Hydrocarbon Chemicals Division of Mathieson Chemical. Formerly chief process engineer at the Morgantown plant.

R. W. McOmie. Manager of Shell Oil's new refinery now under construction at Anacortes, Wash. His successor as manager of company's Wilmington, Calif., refinery: **P. J. Markus,** with company since 1934, most recently as assistant to the manufacturing vice president.

Donald W. Oakley. Plant manager of Metal & Thermit Corp.'s Carteret, N. J., plant. With company since 1947. Previously with Du Pont.

Robert F. Gager. Director of research, Snyder Chemical Corp. Formerly with Du Pont's electrochemicals div. and Varcum Chemical Corp.

William H. Winfield. Director of marketing research, Monsanto Chemical Co. With company since 1947, most recently as director of business research for organic chemicals div. Previously with McKinsey & Co. and Weyerhaeuser Sales Co.

G. A. Davidson. Vice president of Standard Oil Co. of California appointed a director.

J. Russell Wilson. Vice president and general manager of Monsanto's newly-formed research and engineering div. Formerly director of company's general development and patent dept, Mr. Wilson is also a member of the Chemstrand board of directors. With company since 1939.

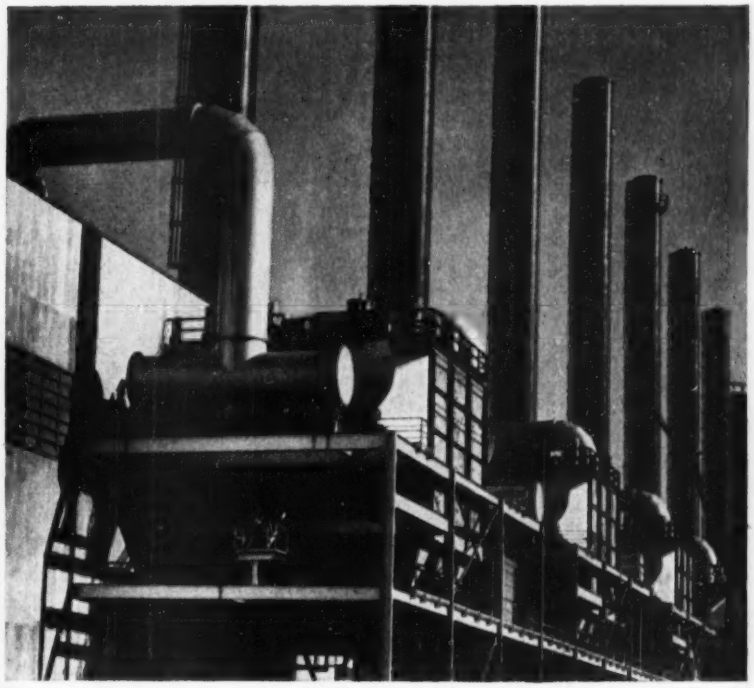
Calvin L. Dickinson. Advisory engineer for American Potash & Chemical Corp. Formerly with Diamond Alkali.

William M. Murray. Vice president, direct sales, Deep Rock Oil Corp. With company for 25 years.

John S. Morrison. Vice president in charge of sales, National Can Corp.

Edward F. Wagner. Manager, Witco Chemical Co.'s Chicago plant. Will continue to serve as director of technical service dept. With company since 1945. Formerly with Standard Oil of Ohio.

Douglas K. Bonn. Head of U. S. Rubber's government dept. in Washington, D. C. With company since 1937 and in the Washington office since 1945.



World's largest open hearth installation of Electrostatic Precipitators installed by Koppers at U. S. Steel's Fairless Works

Nine open hearths at the Fairless Works of U.S. Steel are equipped with Koppers Electrostatic Precipitators. Installed in pairs, these precipitators are minimizing smoke emissions in this thriving industrial community.

No wonder Koppers Electrostatic Precipitators are doing such a magnificent job in reducing air pollution. They are all designed and built to meet the exact requirements of the particular installation.

At our multi-million dollar research center, Verona, Pennsylvania, scientists and engineers are continuously engaged in creating the basis for technical leadership that has become a symbol of Koppers' service. At Koppers' new Mechanical Development Laboratories, Baltimore, continuous testing is conducted in close liaison with research activities at Verona.

Also, Koppers precipitators are designed, engineered, fabricated, erected and guaranteed under one contract by the Koppers Company. So consult Koppers when you have a gas cleaning problem . . . always ready to help you. No obligation, of course. For additional Koppers Electrostatic Precipitator information, mail the coupon below.

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214 Scott St., Baltimore 3, Md.

Gentlemen: I am interested in an analysis and recommendations for my operation. I understand I am under no obligation.

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- **POWER PRESS BRAKES—to 16'-10" long, 400 tons.**
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THIS MONTH'S

Man of

M. J. RATHBONE

New president of Standard Oil Co. (N. J.) was one of the first of the modern mold of ChE's in the oil industry.

How would you feel if one day you found yourself heading the biggest oil company in the world? Well, take it from M. J. Rathbone, brand new president of Standard Oil of New Jersey, "It's a mighty sobering experience."

"When you realize that you're responsible to 270,000 stockholders and to 100,000 employees, mostly career people with Standard, you're a little awed by it all. And, yet, you see it as a terrific challenge and opportunity."

And tall (6 ft. 2½ in.), rangy Jack Rathbone immediately impresses you as just the guy to assume that responsibility, and take advantage of that opportunity. He's the type of fellow you instinctively like. And when you talk to the people around him you find that you're not the only one who feels that way.

In his early days with the company he was elected by his coworkers to a committee which served as the engineer's representative in employee-management negotiations. And he's never forgotten that he was once "one of the boys."

the Month

H. T. Sharp

Jersey's new president has been both a chemical engineer and a Standard Oil man from 'way back. Just as soon as he graduated from Lehigh in 1921, he joined the old Standard Oil Co. of Louisiana—following in the footsteps of his father, brother, uncle and cousin, all Standard Oil men. He was one of the first formally trained chemical engineers in the entire oil industry.

Mr. Rathbone started right in at the bottom of the ladder. In his case the first rung was a drafting board at the Baton Rouge refinery.

As the oil industry grew, so did Jack Rathbone's responsibilities, until eventually he became president of Standard of Louisiana. And in 1944 when that company was merged with Esso Standard, he was appointed president of Esso.

Five years later he relinquished that position to become one of the directors of Jersey Standard—a full-time job.

Though it's been years since Jack Rathbone has had to do any strictly engineering calculations, he still retains his engineering point of view and credits his training as an engineer for helping him to "learn to think straight."

"I guess I've always wanted to be an engineer," he says. "Even in high school and back beyond that I had a strong attraction for engineering. I liked to build things, enjoyed chemistry experiments and monkeying with electrical equipment. I just never thought of being anything else."

Even today when he can spare some time from his work and his "extracurricular" activities—the myriad trusteeships and directorships which he holds—his penchant for "building things" asserts itself. So handy is he at carpentry, electrical work, cement work, and such that he's even built a couple of summer homes.

Sports are another interest, and, though he admits that his scores have climbed as he has ascended the management ladder, Mr. Rath-

Towers, absorbers, scrubbers

Pipe, duct and fittings

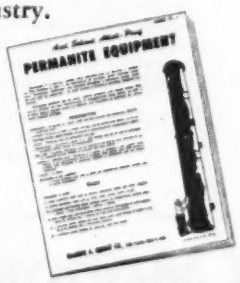
Jars, tanks, sumps, trays

Separators, mixing kettles, surge tanks

The large diameter ductwork above is "made-to-order" for handling corrosive fumes because it is made of Permanite.

Permanite is a furfural alcohol resin structural material reinforced with chemical Fibreglass, which can be formed to almost any shape. It is light weight but very strong and tough and presents a hard non-absorbent surface. Permanite Equipment is corrosion proof throughout its entire body. It will handle most acids including HF, HCl, as well as oil, alkalies and organic solvents to 280° F.

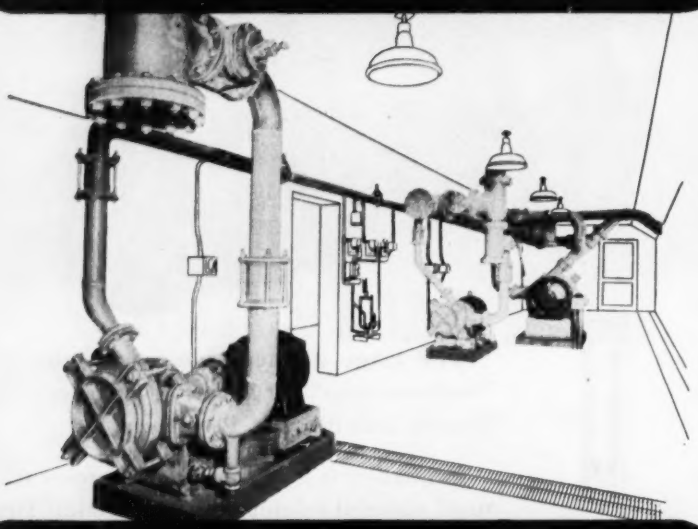
Permanite is used in the construction of many types of chemical handling equipment, large and small. Although individually engineered, Permanite equipment is relatively low in cost and economical in operation. Because of its light weight, it offers an added advantage of speed and facility in handling, shipping and erecting. It is being used for handling corrosives in just about every chemical process industry.



Send for illustrated Bulletin No. 6-B Permanite Equipment, or Bulletin No. 1, Permanite Pipe and Ductwork, and learn how Permanite can help solve your corrosion problems.

Maurice A. Knight 104 Kelly Ave., Akron 6, Ohio
Acid and Alkali-proof Chemical Equipment

Handles extremely thick slurries with high specific gravities



MORRIS Type R SLURRY PUMP

Heavy viscous slurries with solids ratios as high as 70% by volume are not unusual loads for a Morris Type R Slurry Pump.

A case in point is this Morris installation at the Missouri Portland Cement Co., St. Louis, Mo. The two Morris 3R Pumps in the foreground each handle 200 GPM of a cement slurry at 64% solids with 1.66 specific gravity. Speed is 1180 RPM. The 6R Pump in the background handles 600 GPM of the same slurry at 880 RPM.

Long operating life...
little or no maintenance

Massive running parts of the Type R compensate for the increased load imposed by high specific gravities. Hydraulic passages are deliberately designed for high concentrations of solids—the result of careful study of wear patterns shown by pumps in the field handling all kinds of abrasive materials. Elimination of areas of throttling and turbulence assures uniform wear of all parts.

There are no internal studs or bolts—no troublesome internal joints and fits. The suction disc liner is merely *clamped* into position between disc and shell. The absence of high stress on the shell permits wide variations in its composition—including materials of high abrasive resistance—to resist wear and extend the operating life of the pump.

Let our engineers consult with you on your slurry pump problems. They'll give you the benefit of 88 years of pump-building experience. Or, write for Bulletin 181.

MORRIS MACHINE WORKS
Baldwinsville, New York
Sales Offices in Principal Cities

MORRIS *Centrifugal Pumps*

NAMES . . .

bone still calls golf his favorite. (Incidentally, even though he doesn't get out on the links very often these days he can still break a 100.) However, he has always been interested in almost all sports and, during his younger days, was an active participant in nearly everything—from football to track and field.

Make no mistake, however, his grandchildren—all five—share first place in any listing of his interests. Their pictures are to be found all over his office.

How do you get to be president of a company like Standard? Here's Rathbone's formula: "I know it's trite, but nevertheless it's true: In order to get ahead, to be successful, the engineer should learn to do two things: (1) get along with people, and (2) think straight—first get all his facts, analyze them to determine the course to follow, then do what has to be done. As I say, it's trite—but it works."

David S. Bruce. Director of operations, Hercules Powder Co.'s cellulose products dept. With company since 1936, most recently as manager of new product promotion for cellulose products dept.

L. Douglas Weiford. Assistant to executive vice-president in charge of government relations, Stauffer Chemical. With company since 1929.

P. Kay Schwartz. President of Proctor Schwartz. His successor as executive vice president: **Myron T. Fleming,** formerly vice president in charge of company's dryer division.

A. O. Jaeckel. President of Davis Engineering Corp., Elizabeth, N. J. With company since 1926, he will continue as general manager.

Robert M. Chesney. Vice president, manufacturing, Deep Rock Oil Corp. With company since 1951, most recently as manager of company's Cushing, Okla., refinery.

Fred W. Gottschling. Director of engineering, Greer Hydraulics.

Samuel Messer. Chairman of the board, Quaker State Oil Refining Corp. With company for more than a half-century.

OBITUARIES

Paul G. Agnew, 72, pioneer leader in standardization in the United States and former secretary of the American Standards Association, died in New York on Jan. 8.

Francis Henry Schultz, 60, manager of the North Coast Chemical & Soap Co. of Seattle, died in Seattle on Jan. 15. With company 25 years.

Charles Almy, 65, co-founder of Dewey and Almy Chemical Co., died in Massachusetts on Jan. 22.

Neil E. Salsich, 70, vice president and director of Jeffrey Mfg. Co. of Columbus, Ohio, died in Bethlehem, Pa., on Feb. 2, With Jeffrey since 1931. Formerly with Penna Steel Co. and Bethlehem Steel.

Thomas R. Heyward, J., founder of the Duraloy Co., died on Feb. 1.

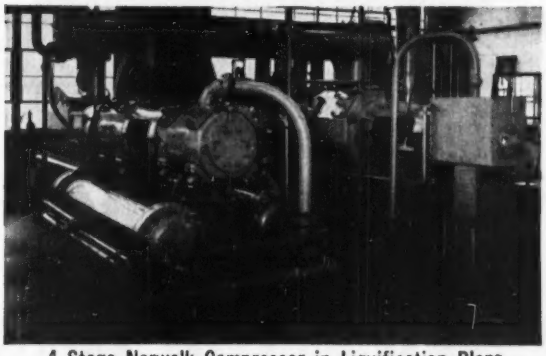
Jacques Phillip Wolf, 80, founder and president of Jacques Wolf & Co., died in Montclair, N. J., on Jan. 26.

Carl Franklin Braun, 69, head of C. F. Braun & Co., San Francisco, Calif., engineering firm specializing in design and construction of oil refineries and chemical plants, died Feb. 4.

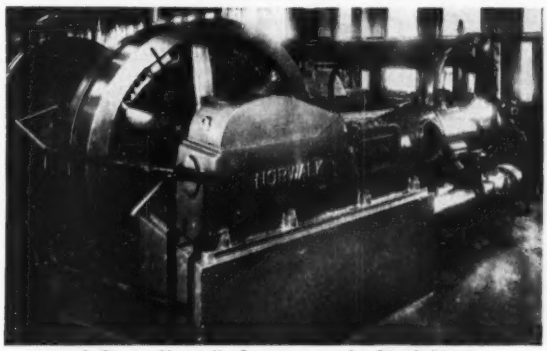
George F. Olsen, 74, retired director of General Petroleum Corp. of Los Angeles, Calif., died Feb. 9. With company since 1925.

Charles J. Durban, 61, advertising and sales promotion executive with United States Rubber Co., died Feb. 10 in Norfolk, Va. With company since 1937.

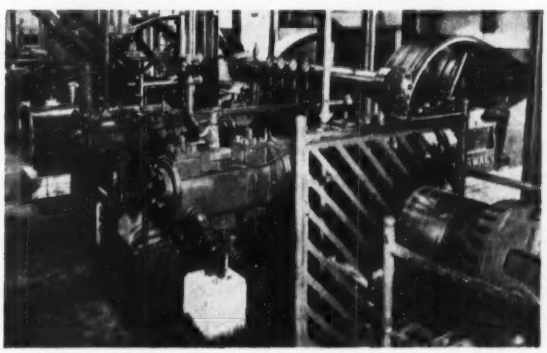
3 HIGH PRESSURE COMPRESSORS



4 Stage Norwalk Compressor in Liquification Plant



4 Stage Norwalk Compressor in Steel Plant



4 Stage Duplex Norwalk Compressor in Dry Ice Plant

Norwalk compressors are built to individual specifications, range from single stage to five and six stages with pressures up to 25,000 pounds. Each compressor is test-run for eight hours at the factory to assure efficient, trouble-free operation. Descriptive catalog forwarded promptly on request.

NORWALK COMPANY, INC.

SOUTH NORWALK, CONNECTICUT

90 years of high pressure experience 1864-1954

designed and built . . .

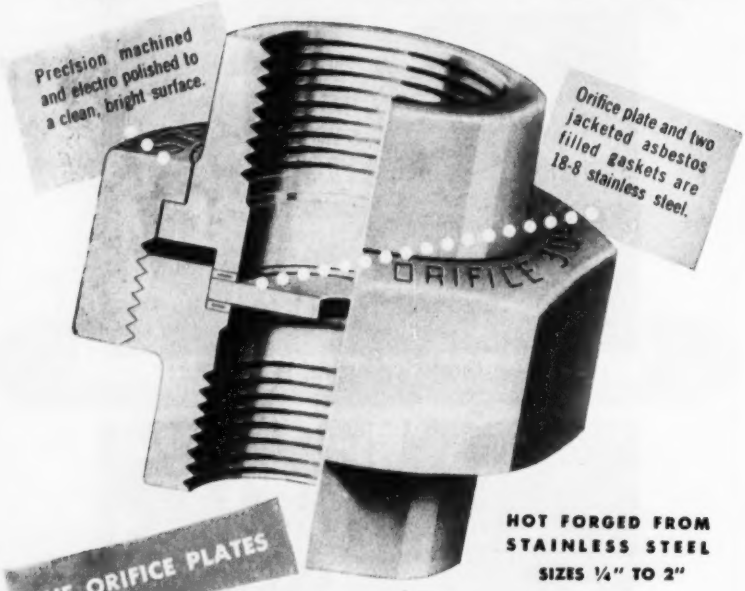
for top performance on all metering, measuring and flow control services.

STAINLESS STEEL

ORIFICE 304

STAINLESS STEEL

ORIFICE 304 DUAL


Precision machined and electro polished to a clean, bright surface.
Orifice plate and two jacketed asbestos filled gaskets are 18-8 stainless steel.
ORIFICE
THE ORIFICE PLATES

HOT FORGED FROM STAINLESS STEEL SIZES ¼" TO 2"

and gaskets are set in a groove of solid stainless steel to facilitate tightening and safeguard against blowing of gaskets. Plates drilled to specification or perforated for use as strainer union. Solid plates can be used for blanking off.

ORIFICE 304 unions are all stainless steel (Type 304) with recommended working pressures of 3000 pounds at 250° F. on services where stainless steel is required. Type 316 and 347 stainless steel ORIFICE unions are also available.

ORIFICE 304 DUAL is our trade name for unions with stainless steel ends, gaskets and plates and carbon steel (Udylited) nuts. Available with Type 304, 316 or 347 stainless steel and recommended for service where atmospheric pressure is not a problem.

C. M. & CO. ORIFICE forged steel unions have, for years, been recognized as leaders among all orifice unions for outstanding dependable service.

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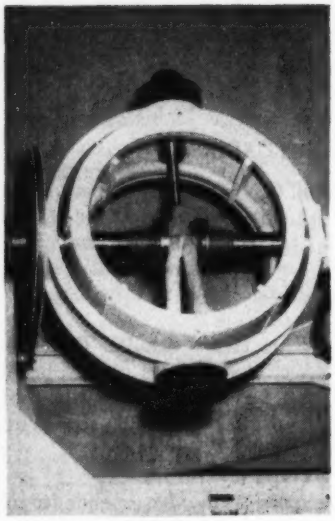
THIS MONTH'S

Letters:



No Gyroscope, This!

Sir:

Your Process Equipment News section in February had one of the most interesting developments I've read about in a long time. It was the item (p. 270) describing the Gyro flowmeter developed by Control Engineering to give true mass flow rate metering.

Your comparison of the gyroscope-like features of the flowmeter (see cut above) is appropriate . . . how it uses fluid momentum in a circular pipe to simulate the action of a gyroscope . . . how the principle of gyroscopic precession is utilized to give accurate reading of mass rate.

The Gyro brought back memories of a physics prof at Northwestern trying to explain the gyroscope to a bunch of green and frustrated freshmen!

V. J. THOMAS

Engineer
Shell Oil Co.
Los Angeles, Calif.

▶ *The ingenious Gyro flowmeter, developed by Control Engineering Corp. of Norwood, Mass., is a brand-new development that'll become commercially available within about six months. It has already stirred up unusual interest among chemical engineers, especially those in the petroleum refining and petrochemical fields.*—ED.

Pro & Con

72 "Cost" Articles . . .

Sir:

I appreciate the articles on costs that you've been publishing over the past few years. They have filled a definite need, and I save each one of them. Just recently I had occasion to put to practical use some of the data on cost estimation you published back in 1949.

Congratulations . . . and please keep them coming!

JACKSON SPARKS
Process Engineer
Louisville, Ky.

▶ *Yes, we'll keep them coming. In fact, we publish at least one article on some phase of "costs" or "cost estimation" practically every month.*

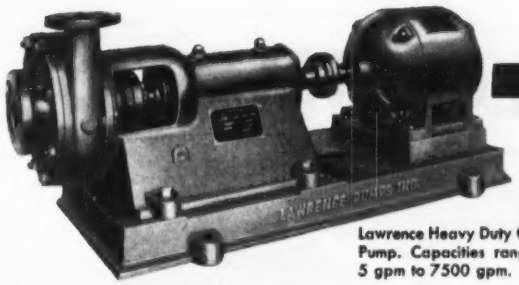
It's interesting, too, that since 1947 (when our present series got under way) we've published 73 articles—268 pages—on costs and cost calculations for the chemical engineer.

But there are still many subjects and fields that haven't been scratched. Frankly, we're in the market for good articles any of our readers might be able to contribute along the line of engineering economics.—ED.

New Format: 90+% Pro

Sir:

Congratulations on your new format that does away with the mixing of ads and editorial on the same page for technical items. . . . A big improvement. . . . Best thing you've done in the 14 years I've been a subscriber. . . . Makes CE much easier to read and to follow. . . . You are to be congratulated on making the first move. . . . Long over-due. . . . Increases value of the entire magazine. . . . Solves the problem I've griped about so many years. . . . I'd like to see you do away with "mixed" pages altogether. . . . Certainly a move in the right direction. . . . Bravo for leading the way, now let the others follow. . . . It definitely improves the usefulness of the publication. . . . Now I'll enjoy reading both the editorials and the ads in my own way. . . . I like it. . . . Glad to see it recognized at last that mixing ads and editorials



Lawrence Heavy Duty Chemical Pump. Capacities range from 5 gpm to 7500 gpm.

HORIZONTAL

ACID and CHEMICAL PUMPS

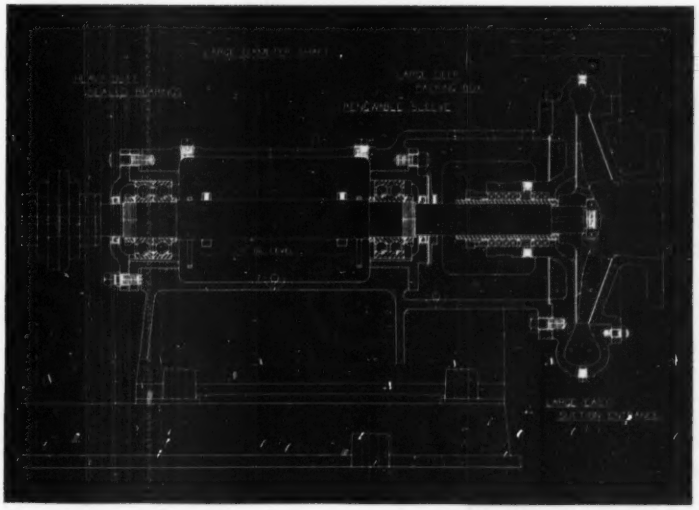
No class of service puts a more exacting duty upon pumps than the chemical and process industries. The problem is not simply the handling of a fluid, but of resisting the destructive action of the fluid itself.

In this difficult field Lawrence engineers have had repeated and successful experience with practically every "pumpable" fluid. The range of materials pumped includes all kinds of acids, caustics, dye solutions, bleach solutions, various oils, syrups, fruit and vegetable juices, pulps, and liquids carrying a high percentage of abrasive or solid matter in suspension.

The metals and alloys used in Lawrence acid and chemical pumps are carefully selected for their ability to resist the corrosive and abrasive action of the liquid pumped. Those most commonly used are: stainless steel, nickel, Monel, bronze, Hasteloy, Ni-resist, lead, aluminum, iron and steel.

If your problem involves pumping acids, chemicals or slurries write us the pertinent details. No obligation.

Write for Bulletin 203-6 for summary of acid and chemical pump data.



Cross-section of Lawrence Heavy Duty Chemical Pump.

LAWRENCE PUMPS INC.

371 MARKET STREET, LAWRENCE, MASS.

Saves $14,000 per year

How Woodall Industries Uses Pangborn to Reclaim Wood Dust for Fuel

Mass production of made-to-order Masonite parts means mass production of dust and fine shavings as hundreds of parts per hour are sawed, punched, sanded, molded, drilled and shaped from sheets of Masonite. But Woodall Industries, Inc. put this scrap to work in its Mineola, L. I. plant with the help of a Pangborn dust collection system.

All this dust generated in processing is collected, transported to bins and then burned as fuel — providing all the fuel for both heat and processing requirements. In just one year, Woodall estimates that the savings amounted to over $14,000 in fuel alone —plus additional savings in plant maintenance costs. Employee health and morale, too, gain from this Pangborn-planned program of dust control.

Pangborn Corp., 2600 Pangborn Blvd., Hagerstown, Md.

How Much Can Pangborn Dust Control Save You?

Pangborn engineers are ready to discuss *your* Dust Control problems — large or small, and show you how Pangborn equipment can save you time, trouble and money. Write your name and company address on the margin of this ad and mail in today for a no-obligation discussion.

Pangborn DUST CONTROL

STOPS THE DUST HOG FROM STEALING PROFITS

PANGBORN'S 50TH ANNIVERSARY • 1904-1954

PRO & CON . . .

doesn't force anybody to read either. . . . Better for the advertisers, too. . . . My thanks for making the move. . . . Vast improvement. . . . wish all technical magazines would do the same. . . . Will read ads more carefully now. . . . A constructive move.

Don't see anything to get excited about. . . . Good move if you'd carry it all the way. . . . See little difference. . . . Don't like what you've done to the departments. . . . Wish you'd remove all ads completely away from editorial. . . . It's OK, I guess. . . . So what?

CE READERS
Chemical Process Industries
U. S. A.

▶ *The comments above, selected from literally hundreds of letters and notes, reflect the feelings of CE's subscribers to the new format we put into effect in January. So far, the tally has been a whopping 9.4:1 in favor of our move.*

This new format has one major objective: To increase the value and readership of editorial and of advertising by cutting down—and eliminating wherever feasible—the mixing of advertising and editorial matter on the same page. This practice of mixing the two, gaining momentum in recent years, is now common among practically all publications, technical and general.

Said the editor of one leading technical publication recently: "Like most editors, we've resisted the trend toward excessive split pages by griping and complaining and yelping—but doing nothing. I'm glad to see Chemical Engineering take steps—positive steps—to correct the situation. You'll have a much better magazine for both readers and advertisers.—ED.

Sharpen Your Knife

Sir:

In a letter to the editor (Dec. 1953, p. 160), D. S. Davis suggests the use of a 6H pencil for cutting out pages of *Chemical Engineering*.

The letter should read ". . . a (dull) knife usually burrs up the paper. . . ." I often use a sharp knife and cut many pages with one stroke, e.g. the Process Piping report.

E. H. BARNETT
Webster Groves, Mo.

▶ *Be sure your knife is sharp.*—ED.

Petro-Obsolescence?

Sir:

The article "Evaluate Your Depreciation Charges" in February (p. 195) gave in concise form some mighty useful information on depreciation, deterioration and obsolescence. Among other things, I was interested in the list which showed the income-tax approved useful lives of various equipment items in the chemical and oil refining industries. . . .

But I couldn't tear my eyes off the picture (see above) you titled "Obsolescence." Does it have any special meaning?

JACK M. STERN
Chemical Engineer
Ponca City, Okla.

▶ *Maybe "Obsolescence" does have a special meaning after all. If you'll look closely at the photograph above you can read the name of one of the thriving companies occupying the building at the bottom of the hill: Shoe & Leather Petroleum Co.*

Does this suggest that the petrochemical industry, today's glamorous darling of Wall Street, sprang from such humble beginnings on the petro side of her family? And back in 1865 at that?

Certainly it proves that the modern leather industry is actually just another member of the petrochemical family. And evidently a legitimate member too!—ED. (Continued)

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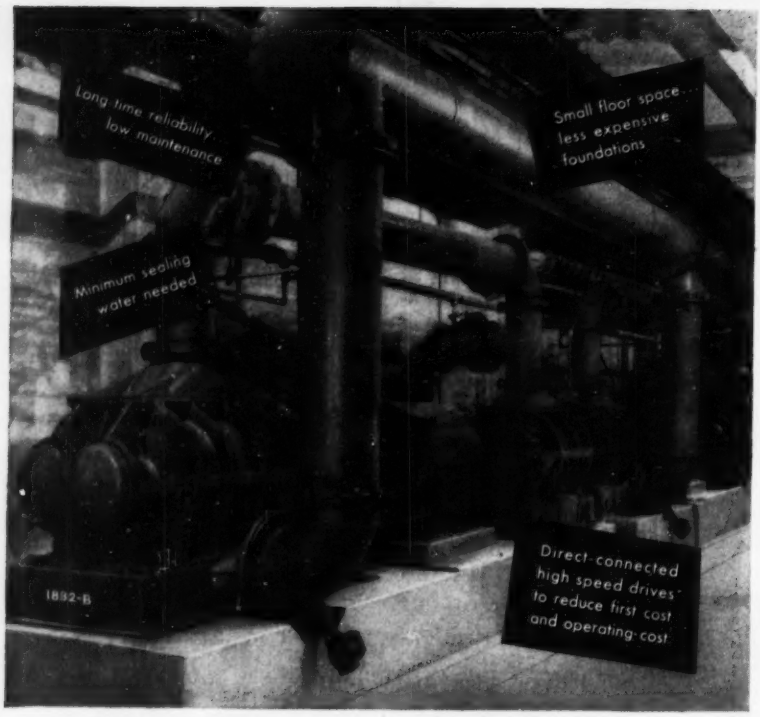
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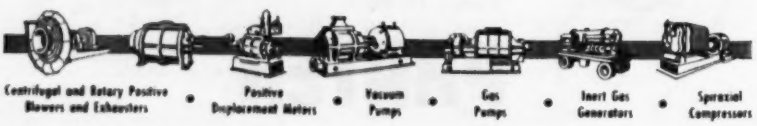

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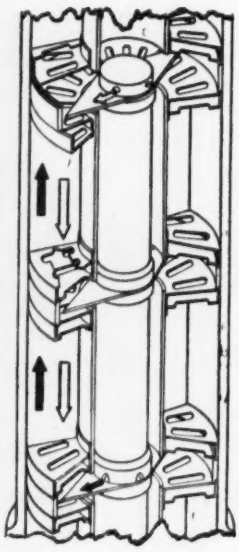

Inside a Spinning Tube

Sir:

What happened to p. 284 in your February issue?

I was really interested in Sharples' new centrifugal liquid-liquid contactor in which immiscible liquids are alternately intermingled and separated.

But the top of the page was defective, and the drawing that showed how the unit works was missing entirely! What am I supposed to do now. . . ?

MORRIS SCHUMANN
Far Rockaway, N. Y.

▶ *For the benefit of those few subscribers who received defective copies, we're reproducing the drawing (see cut above) that appeared on p. 284 of our February issue.*

This shows several extraction stages, and how the tubular bowl and chambers rotate about the shaft of the Super-Centactor (developed by Sharples Corp. Research Laboratories). The black arrow shows flow of the heavy liquid, the white arrow that of the light liquid. Within the bowl are alternate mixing and settling chambers; each mixing chamber rotates around a mixing blade on the stationary center shaft.—ED.

Viva El Ing. Corrigan!

Sir:

For many years I have been an assiduous reader of your publication and it would be impossible to list all the benefits received from your

articles both as concerns my work and from the standpoint of professional knowledge.

But nothing has proved more helpful than your recent CE Refresher series. On leaving the Polytechnic Institute, we all had a great fund of information, but without any opportunity to use it right away in our daily work in industry. So our knowledge of theory was pushed into the background of memory; when the need arose we had to get out our old texts, which by then were divorced from immediate reality.

Therefore, nothing could be more welcome than Mr. Corrigan's articles. They are so fresh, practical and instructive that everybody who has read them exclaims, "Just what fills the bill!"

It is the deepest wish, both of myself and of my colleagues, that the CE Refresher series be continued. We would like to see them extended to include other fields such as physics, electrochemistry, gases, liquids, studies of phases, higher mathematics, etc. . .

Again I wish to express my pleasure in your initiative. . . .

KURT STERNBERG
Industrial Chemical Engineer
Buenos Aires
Argentina

► *We appreciate these comments from Engineer Sternberg and his associates in Buenos Aires. We hope to extend the Corrigan "Refresher" series to cover other subjects not included in our original plans.*—ED.

Fileability Fiasco?

Sir:

Like others, I find many articles in CE that're both interesting and useful. I try to clip and save many of them for future reference.

I was happy to read that your policy will be to arrange feature articles so that it'll be easier to clip them without destroying parts of adjacent articles. As you stated, your policy went into effect in the January issue.

I therefore made a modest sort of survey of the February issue. Of the nine feature articles, five started on the left side, four on the

THE
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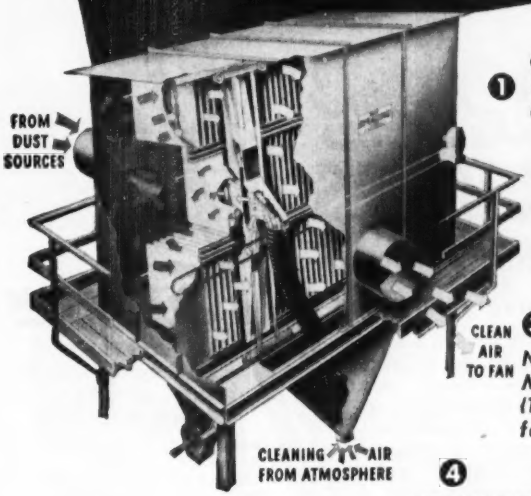
The ULTIMATE in Dust Filters



1 CONSTANT SUCTION at dust sources.
2 SELF CLEANING for continuous operation.
3 NO AUXILIARY MOTORS or BLOWERS (The main operating fan does the cleaning).
4 NO ABRASION of BAGS by the CLEANER.
5 LESS OVERALL HEIGHT and FLOOR SPACE.

HOW IT OPERATES

(a) Dust laden air is drawn in from the dust sources as indicated by the shaded arrows.
(b) It is diffused into the dust chamber by the baffle plate.
(c) It is then drawn through the fabric of the filter bags and is cleaned as shown by the clear arrows.
(d) Clean air passes out of the case and goes to the suction fan.
(e) Concurrently, the traveler moves back and forth across the dust wall registering successively with one bag at a time.
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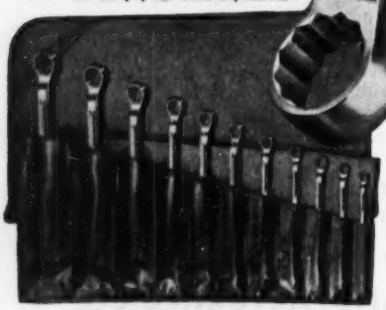

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PRO & CON . . .

right. Six of them could not be clipped without destroying parts of adjacent articles.

This leads me to believe that you'll have to take further steps to uphold your new policy.

R. S. WIENER

Stamford, Conn.

▶ *We sure will! And we're beginning to think we grabbed a bear by the tail, too.*

Our new format—started in January—did achieve one major objective: You can now file all feature technical departments as complete units without having to include any "split" pages (those with both editorial and ads on the same page).

But with feature articles, we didn't fare so well. Should we cut—or expand—all articles so that they come out to an even number of pages, hence make them fileable as units without destroying parts of adjacent articles? Authors wouldn't go for that at all. Neither would you nor we, for this would damage most articles.

Should we back up odd-page articles with ads? We've done enough research to know that most of you wouldn't go for that either.

Should we stagger technical, engineering or permanent-type articles with general, descriptive and non-permanent news or articles? You don't like that. Besides, it violates our basic principle of trying to make every article worthwhile and of practical, permanent value to chemical engineers throughout the process industries.

So, you see, we do have a real problem. But we're determined to do something about it even though we'll probably never be able to satisfy everyone all the time.

I'm sure we'll have your patience and understanding in our efforts to solve a problem that few technical publications have solved, or even tackled.—ED.

Economic Attractiveness

Sir:

Capitalizing costs, as Mr. Jelen's article in your February issue (p. 199) suggests, is a big improvement over many of the other economic evaluation procedures in common use.

As an engineer who has turned economist and is now being converted to a financier, I am pleased to see proper respect paid to the cost of capital in engineering economy studies. Although I have not yet confirmed this, I believe Mr. Jelen's method may help fill a gap

in my own theories. This gap is in connection with repetitious investments such as automobiles.

"Capitalized Costs" is based on the theory that investments wear out and must be replaced indefinitely. When this is true, the method may be a valuable tool. But when it is not true, its value may be questionable.

It has been my experience in the petroleum industry that even when so-called replacements are made, the new units often bear little resemblance to the equipment being replaced. Many new investments are not replacements and the probability of their replacement often appears remote.

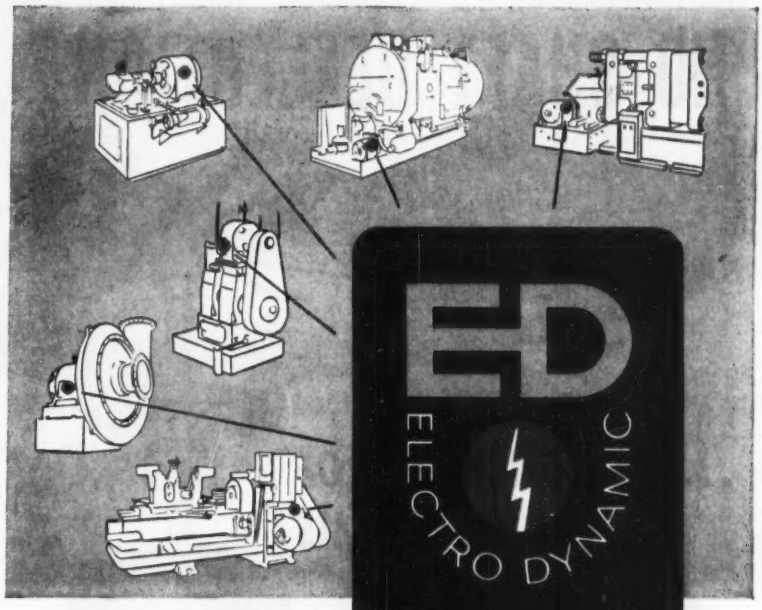
While the theory of repetition on which "Capitalized Costs" is based may be applicable generally to railroad equipment and in exceptional cases in most industries, I suspect that its general use in the process industries will not always produce the optimum economic result.

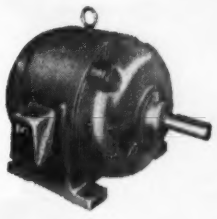
When the generalization of repetition is not true, I suspect that the "Capitalized Cost" method will show the common failing of other evaluation systems: An unreasonable degree of sub-optimization. Even if this were not true and if the best action of a series of possible actions could be correctly selected, I am not clear about how one would determine that the commitment is justified.

This leads up to my basic premise: To develop a procedure of economic analysis which will evaluate the benefits expected from a proposed action in such a way as to provide a basis for deciding whether to act or not, it is first necessary to know what benefits are considered desirable.

In developing this premise, we found it extremely important to determine the cost of capital with reasonable accuracy and in considerable detail. This has involved study of our income statements and balance sheets and consideration of company policies.

It was as a result of working on this cost of capital assignment that we developed our theories. In applying the cost of capital, we found





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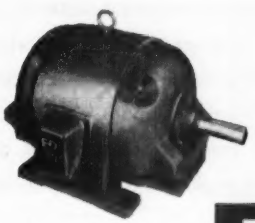

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H. PFORZHEIMER
Standard Oil Co. (Ohio)
Cleveland, Ohio

▶ *Engineer-turned financier Pforzheimer has promised to prepare for us an article describing the new theory of "economic attractiveness" developed and in use at Standard Oil Co.*—ED.

A Service to All Engineers

Sir:

The "bible" of our profession—Perry's "Chemical Engineers' Handbook"—contains a great deal of valuable cost and economic data for chemical engineers.

But Perry's index does an inadequate job of making these data easy to find. There are only two items under the head of Economics and 16 under Costs (five of these refer to two small tables on columns and column packings).

Dryers are not even mentioned in the index under Costs. Nor are costs mentioned in the index section (about 90 items) on Drying and Dryers. Yet the dryer costs in Perry are as extensive and detailed as any I know.

Such important subjects as distillation, extraction, absorption, size reduction, furnaces and kilns include equipment data—but nothing on costs. It's difficult to choose a piece of equipment in these fields without regard to costs.

I hope that in the next revision more of the authors may see fit to include cost data as complete as those by Marshall and Friedman on dryers.

Meanwhile, I have compiled a fairly complete index for those engineers searching for cost items or economic information in Perry's Handbook (1950 edition). I hope

it serves to ease the problem of engineers using the Handbook for this purpose.

JAMES B. WEAVER
Olin Industries, Inc.
E. Alton, Ill.

▶ *Engineer Weaver (who recently joined the Planning Division of Atlas Powder Co. in Wilmington, Del.) has given us permission to publish his index of cost and economic data in Perry.*

In behalf of chemical engineers everywhere, we wish to thank Mr. Weaver for making his valuable index generally available. It will be a real service to the chemical engineering profession. Mr. Weaver's complete index is given below.—ED.

Cost Index to Perry

Index of cost and economic data in "Cherical Engineers' Handbook" (1950 edition, edited by John H. Perry). Compiled by James B. Weaver.

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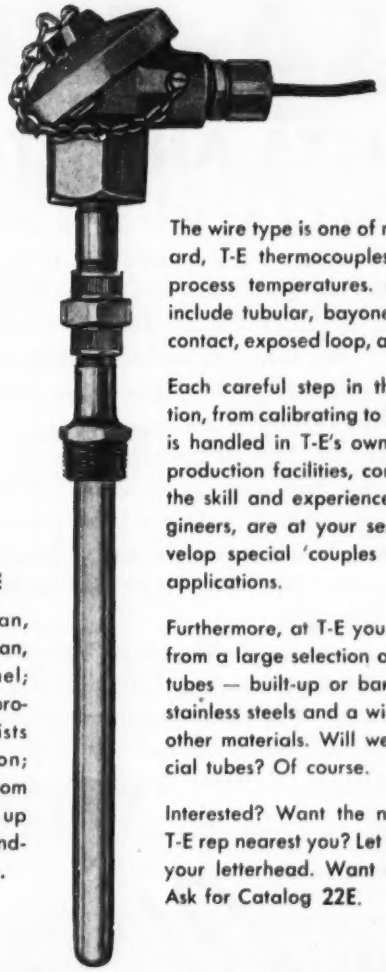
CERTAINLY. TRY AND NAME A THERMOCOUPLE T-E DOESN'T MAKE.



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Site costs 1721, 1728-9

We welcome short, pertinent letters from our readers giving their opinions on developments in the chemical engineering profession and in the chemical process industries. Address the Editor, Chemical Engineering, 330 West 42nd Street, New York 36, N. Y.

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——LITTLE BONER——

Too Darn Many Cycles

The new ammonia-nitric acid plant was a beauty. For one thing, it had the very latest in process controls; no half-way measures here!

But the ammonia flow wouldn't stay steady even though it was controlled by one of the very best makes of pneumatic recorder-controllers. It would always cycle a wee bit. Not very much, true—but just enough to play hob with the plant.

Naturally these ammonia cycles led to corresponding cycles in the composition of the ammonia-air mixture going to the NO_2 burner. So the burner temperature cycled, too, and the glow of the platinum catalyst would rise and fall. The plant manager was an unhappy man as he watched the cycle of that glow, for it peeled dollars right off the life of that precious platinum gauze.

For weeks the instrument engineers puttered and fumed in embarrassment. Nothing helped: The ammonia had to be regulated manually and the fancy recorder-controller did nothing but record. That was that, and a cold fact.

Finally one engineer decided to take a look at the air compressor itself—a massive steam-driven machine with an 8-ft. flywheel rotating with majestic aloofness on its concrete throne a quarter of a mile away from the ammonia plant.

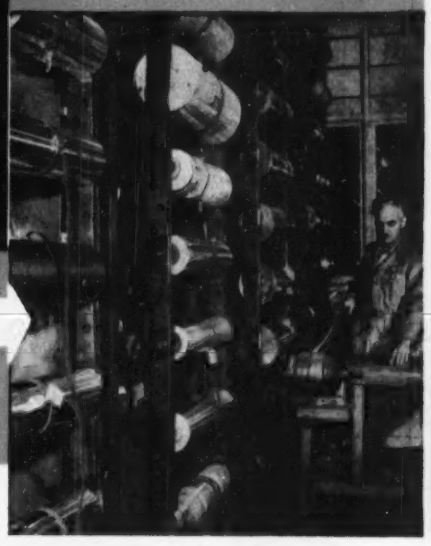
Sure enough, a stroboscopic light directed against a row of notches around the flywheel showed that its speed rose and fell in exactly the same cycles as those of the ammonia in the nitric plant.

What happened was that the compressor governor caused a small cycle in speed—which gave rise to a similar cycle in the air flow—which kept the flow controller upset—which caused all the trouble all along.

"We found it a heck of a lot cheaper to keep on regulating the ammonia flow manually than to buy another governor for that big compressor," says the engineer who told us this true story. "And we aren't so hepped up about the wonders of automation as we used to be, either."

If you have a true "little boner," why not send it to the Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y. We reveal no identities!

Each Kel-F lined rupture disc is given a leak detector test and must be proven pin-hole free.



The large stock of controlled ductile metals used in the manufacture of BS&B rupture discs enables us to duplicate a previous requirement as well as affording you a wide selection in pressures — from 5 to 50,000 lbs.

For CORROSIVE Conditions

Equip Your SAFETY HEADS With BS&B Kel-F Lined Rupture Discs!

Whenever BS&B Safety Heads are installed in a location where corrosive conditions exist, an unprotected metal rupture disc may be vulnerable to corrosive attack from either the product or the atmospheric side—or both.

The recommended disc to use under these circumstances is the BS&B Kel-F lined rupture disc, which has for more than 3 years proven its resistance to corrosive attack from strong acids, caustics, chlorine, etc. Kel-F is a trade name for a thermo-plastic film of trifluorochlorethylene, which is also known by the trade name of Trithene. Discs may be specified with the Kel-F lining on either or both sides, as your conditions may require.

The use of Kel-F linings in combination with metals of known mechanical and metallurgical qualities such as Inconel, Monel, stainless steel, and nickel means positive, trouble-free protection in highly corrosive applications heretofore impossible.

Thus, through "know-how" attained by years of experience in this highly technical field, BS&B has again provided the Process Industries with a *better* safety device for the protection of closed pressure systems!

For full information on the BS&B Kel-F lined rupture disc and its application to your specific problem, consult your BS&B Office or Representative . . . or write to us direct.

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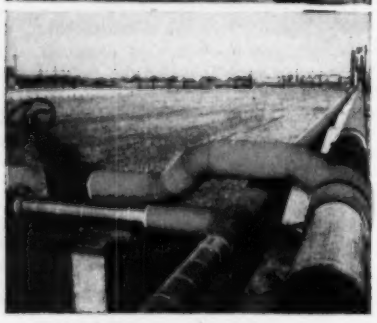
"That new snap-on pipe insulation" that's causing so much comment in industry is G-B ULTRAFINE PIPE INSULATION. It's the first and ONLY one-piece molded pipe insulation of fine glass fibers — ideal for hot or cold piping, for plant maintenance or new construction.

To the many advantages you see illustrated below, you can add ECONOMY. G-B ULTRAFINE PIPE INSULATION costs no more than other insulations, and users report APPLICATION SAVINGS UP TO 50%!

ONE MAN, ONE HAND — that's all it takes to handle new G-B ULTRAFINE PIPE INSULATION. (This 6-foot section weighs just a shade over 4 lbs.!) No harm done if the workman should drop it — for this insulation is flexible and resilient, won't break or crumble.

A "SNAP" TO APPLY — simply pull the single seam apart, and G-B ULTRAFINE PIPE INSULATION snaps itself around the pipe! No special tools or skills required. With any knife, you can readily cut this new insulation to go around obstructions.



EASY TO FINISH — simply close seam tightly with any standard type fastener — then paint . . . leave "as is" . . . or finish as desired. Thermal efficiency of the finished job is so superior that you get the same "heat saving" with less wall thickness!

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WHAT'S HAPPENING . . .
(Continued from page 144)

Brea Chemicals to Produce Nitric and Nitrate

Nitric acid and ammonium nitrate will be produced by Brea Chemicals, Inc., in a new $2.5 million plant to be built next to the $13 million ammonia plant now under construction at Brea, Calif. The nitric acid and ammonium nitrate plant will be built by C. F. Braun & Co.

The $13 million ammonia plant is now under construction at Brea for the Amoniaco Corp. It is leased and will be operated by Brea Chemicals when completed in April. Most of the initial output will be marketed as aqua ammonia fertilizer solution in the western United States, Hawaii and Mexico.

Nitric acid and ammonium nitrate will be made from ammonia. Nitric acid is widely used in metallurgical and industrial processes and is a strategic material in the production of explosives and propellants. Ammonium nitrate will be marketed for both agricultural and industrial uses.

New Kansas City Plant to Make Sealing Compounds

As part of a $750,000 expansion during 1954, Permatex Chemical Co., producer of sealing compounds and maintenance chemicals for the transportation and other industries, will construct a $500,000 plant in Kansas City, Kan. The plant will be ready for operation in August.

"Our decision to establish operations in the Kansas City area," declares President C. A. Benoit, Jr., of Permatex, "was influenced by Kansas City's ideal, centrally situated transportation facilities which will enable us to carry forward a steady program of expansion and improvement of our services to automotive, aviation and industrial customers in the Midwest, West and Southwest."

The new plant will be of modern design with a two-level manufac-

turing area utilizing gravity to minimize the pumping of compounded products. The upper level of the manufacturing area will be for mixing and manufacturing, while the lower level will be for packaging.

The structure will include an 18-ft. high warehouse area. The height was selected for the most efficient storage of palletized materials.

An outside tank farm will be provided next to the receiving area for the storage of oils, alcohols and solvents. These will be pumped from the outside tanks through pre-selector type meters to the second floor manufacturing area.

The new Kansas plant will be used for the expanded volume manufacture of major products such as hydraulic brake fluid and sealing compounds for the automotive and aviation industries.

Filtering Sulfite Liquor Helps to Abate Pollution

One-fourth of all spent sulfite liquor produced in its pulp mill at Wisconsin Rapids, Wis., is now being used by Consolidated Water Power & Paper Co. to test a soil filtration process for reducing sulfite stream pollution.

"If the experiment turns out satisfactorily," says G. K. Dickerman, technical director for Consolidated, "all the mill's sulfite liquor may eventually be pumped to large filtration beds and processed by this method before release to the Wisconsin River."

A system of four soil filtration lagoons has been constructed on a tract of riverbank land two miles from Consolidated's big mill. Tank trucks haul hot liquor from the mill to these lagoons. To reach the stream, lagooned liquor must pass through many layers of sandy soil. While it is thus underground, natural biochemical activity in the soil consumes much of the wood sugars in the liquor, which otherwise would use up oxygen in the river water.

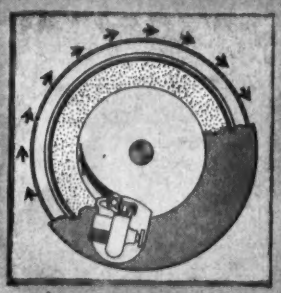
Constant laboratory testing of the effluent indicates that soil filtration reduces the oxygen demand of

safe

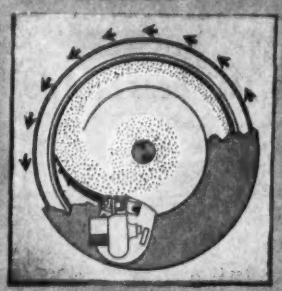
CENTRIFUGALS

Keep plant accidents at a minimum and maintain constant production with the safest centrifugal in the chemical industry today.

The Roberts G-8 Automatic Electric Drive Centrifugal features many unique developements which until now have been wanted, but not achieved.



SPINNING



PLOWING

REVERSE PLOWING—Completely eliminates the hazard of accidental plowing during the spinning operation. (See illustration.)

OVERLOAD PROTECTION — Loading gate closes automatically when basket has received predetermined charge.

TEMPERATURE—High speed connections are further protected by thermal overload device built into the motor.

CURBING — Completely enclosed.

UNBALANCED LOAD PROTECTION — Gyration Switch protects machine against possible damage caused by unbalanced load.

REGENERATIVE & MECHANICAL BRAKING — Quick, safe stops are achieved with the G-8 braking system.

These are just a few of the many new features which THE WESTERN STATES MACHINE COMPANY has developed and incorporated into its machines. For additional FREE information on Roberts Centrifugals write The Western States Machine Company, Hamilton, Ohio.

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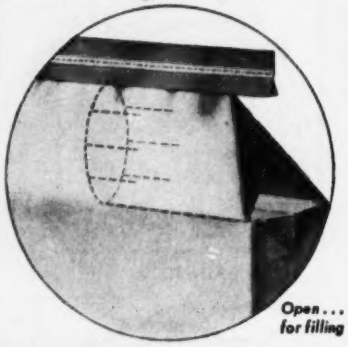
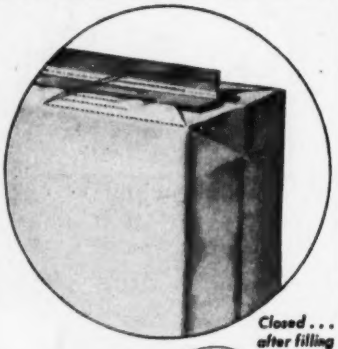
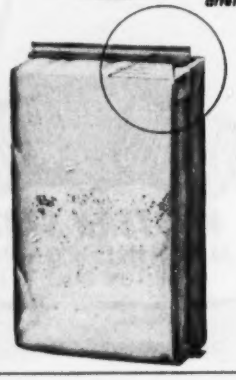


Open... for filling

The FLEX Does the Trick...



Closed... after filling



the spent liquor by a substantial amount. By the time it reaches the stream the liquor has lost much of its strength.

For closer study of soil filtration, Consolidated engineers have made a pilot unit in the mill itself. Here spent liquor is dripped at a controlled rate upon a bed of soil 10 ft. deep. Oxygen demand of the liquor is periodically analyzed as it enters at the top and again as it emerges from the bottom. By varying the conditions in this test unit, the engineers hope to learn how to make the soil filtration process increasingly effective.

Antioxidant Helps Keep Carotene in Alfalfa Meal

Loss of carotene in dehydrated alfalfa meal during storage is greatly reduced by treating the alfalfa with an antioxidant that slows the destruction of carotene by oxygen. The carotene in dehydrated alfalfa meal is converted by the animal system to vitamin A, an essential growth and reproductive factor. Much of the carotene is often destroyed during storage of the meal by combining with oxygen in the air. These losses, according to Henry G. Moeller, president of the American Dehydrators Association, have been a major problem since the inception of the industry.

Now an effective antioxidant has been found. After investigating 400 compounds, researchers of the Western Utilization Research Branch, Agricultural Research Service, U. S. Department of Agriculture, found the most effective antioxidant to be 6-ethoxy-1,2-dihydro-2,2,4-trimethylquinoline. It is produced commercially by Monsanto Chemical Co.

Laboratory and field tests have shown that the addition of only 0.3 lb. of the clear, light yellow liquid to each ton of alfalfa meal may more than double the retention of carotene after six to eight months of storage.

In dehydrating plants already equipped to apply a measured amount of oil for controlling dust,

the antioxidant is added to the oil in the required amount to supply 0.3 lb. per ton of meal. Vegetable oils, such as cottonseed, soybean and rice, have been most commonly used as a carrier for the antioxidant, but animal fats have also been used.

Typical results show retention of about 65 percent of the original carotene content of the alfalfa meal after six to eight months of storage at 75 to 80 deg. F. Untreated meal stored under the same conditions retains only about 25 percent of its original carotene.

This method of preserving carotene in alfalfa can be employed under license from the Agricultural Research Service of the U. S. Department of Agriculture. The achievement, a big advance in the alfalfa dehydrating industry, results from the cooperation of government and university researchers and the dehydrating industry.

Recovery Process Could Spur Hardwood Use

A new process for the recovery of waste liquors from pulp mills not only promises to abate stream pollution but also will recover chemicals and pay for itself, according to the Sulfox Corp. of New York.

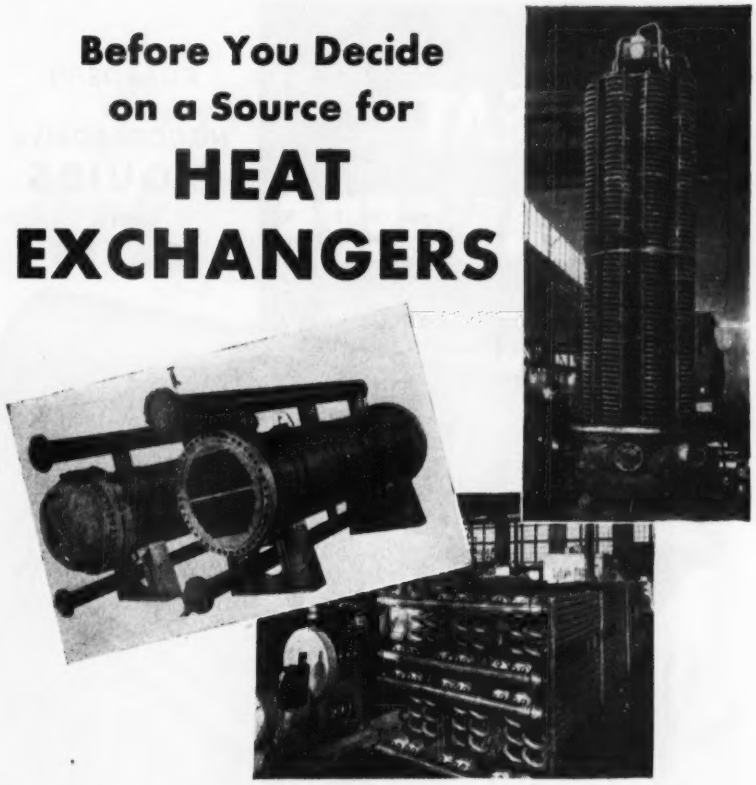
The process can be used on both neutral sulfite semi-chemical pulp and also on the usual sulfite pulp. With the regular sulfite pulp, soda is used as base instead of the lime now generally used. Recovery of chemicals compares with that in modern kraft mills—about 90 percent.

According to Dr. Arthur Pollak of the Sulfox Corp. the process offers the most economical way of recovering liquors from sulfite and semi-chemical pulp mills. Tests indicate that recovery plants could justify the investment more easily than other proposed processes.

Since the process can be used for both sulfite and semi-chemical pulping it should spur the pulping of hardwoods of which the nation has an abundant supply. The semi-chemical process is suited for the pulping of hardwoods and has been

Before You Decide on a Source for

HEAT EXCHANGERS



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VILTER's capacity extends to vessels in many popular size ranges. If stress relieving is indicated, VILTER can handle it. No matter how rigid your pressure vessel requirements, VILTER is ready for you.

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WHAT'S HAPPENING . . .

the fastest growing chemical process during the last decade. One of the handicaps has been the lack of a recovery process. Sulfox believes its recovery process will overcome this difficulty.

New Petrochemical Plant For Warren in Texas

Petrochemicals will be produced by Warren Petroleum Corp. in a new $2 million plant to be built near Conroe, Tex. The O. L. Olsen Co. of Houston, Tex., is erecting the plant, which is expected to be completed by July 1954.

The plant will get its raw materials from the Midland Gasoline Co. It is designed for an annual production of 2.5 million pounds of pentaerythritol, 4 million pounds of methanol and 2 million pounds of acetaldehyde. An improved oxidation process, developed in Warren's research laboratory, will be used to produce the petrochemicals.

Plant to Extract Vitamin From Sewage Byproduct

As a result of an agreement between the Milwaukee Sewerage Commission and the Vern E. Alden Co. of Chicago, Ill., Alden may become a commercial producer of vitamin B_{12} concentrate from a nitrogenous sewage byproduct.

Alden has completed shakedown operations in its pilot plant, and is now in continuous production of vitamin B_{12} concentrate in quantity. These operations have included the redrying of the sewage byproduct Milorganite after the extraction of the vitamin concentrate, and have proved that this "Milwaukee organic nitrogen" is still as effective as ever as a high-grade fertilizer.

The spray-dried vitamin B_{12} concentrate produced in the pilot plant has exceeded expectations, both as to quality and quantity. It is now being considered by manufacturers and producers as a supplement to animal and poultry feed.

The pilot plant in the Chicago area has been operated during the past six months to extract the vitamin B_{12} on a small scale at a cost of over $300,000. The Milwaukee Sewerage Commission has already supplied the pilot plant with more than 60 tons of Milorganite for these processing tests.

Enough vitamin B12 concentrate has now been produced at the pilot plant for Alden to furnish samples to potential users. If the market for the product is adequate, according to the exclusive contract with the Milwaukee Sewerage Commission, the Vern E. Alden Co. will go ahead with the construction of a $1 million plant for the production of B_{12} concentrate at the sewerage treatment site on Jones Island.

B_{12} concentrate produced in the pilot plant has none of the characteristics of the clean and sterile Milorganite granules from which it is extracted. The spray-dried product is a light coffee color and has an odor like caramelized sugar. Assays indicate that it contains as much as 15 to 20 mg. of vitamin B_{12} activity per pound.

It was Dr. Bernard Wolnak of Miner Laboratories in Chicago who discovered the B_{12} in Milorganite and developed and patented the original extraction process for the Milwaukee Sewerage Commission. This and other pending patents have been assigned to the commission by Miner Laboratories. During the pilot operations, Miner has continued as consultant to the Alden organization.

Producing about 70,000 tons of Milorganite annually, the Milwaukee plant could yield about 140 kg. of pure vitamin B_{12} activity each year, equivalent to 308 lb. of the pure vitamin per year. The vitamin B_{12} concentrate to be produced in the commercial plant contains only about 20 mg. of activity per pound. Thus the annual production of concentrate powder in the commercial plant could amount to as much as 7 million pounds per year.

However, the entire production of Milorganite may not be processed for the recovery of vitamin B_{12} concentrate. Only enough may

This modern cane juice clarification station is installed at Sucrerie de Savanna on the Island of Reunion. Engineered by our associates in France, Societe Dorr-Oliver, it consists of two Dorr Multifeed* Clarifiers and an Oliver-Campbell Cane Mud Filter.

When it comes to satisfying the craving of a "sweet tooth", you'll find Dorr equipment at work the world over. Every year, Dorr Clarifiers transform raw cane juice into 25 *billion* gallons of the clear solution that is the start of high quality cane sugar.

Chances are your interest in sugar stops with the morning coffee. But the unit operations employed in its production are basic to a host of industries . . . and yours may be one of them. Whenever a process involves the separation of finely divided particles in suspension, the use of ion-exchange, or fluidizing techniques, Dorr and its Associated Companies throughout the world can provide the correct equipment for your job.

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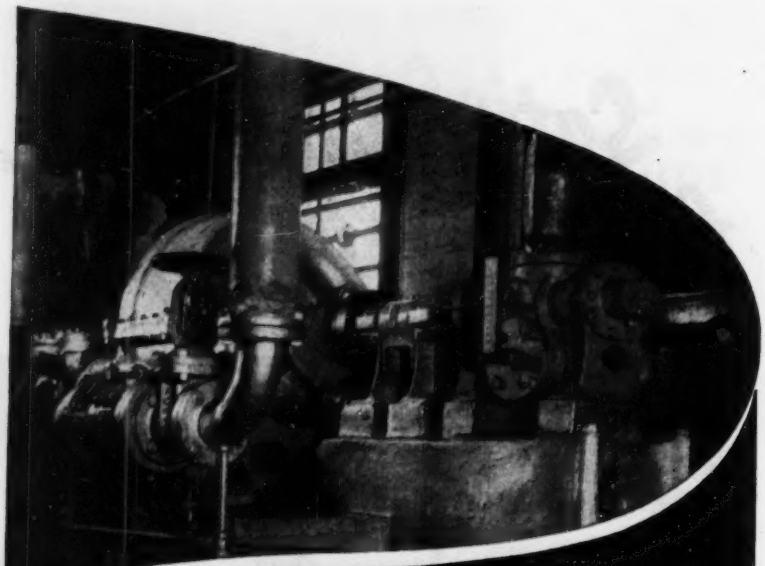

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at American Cyanamid Warner's Plant

Linden, N. J.

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POWER PLANT OR PROCESSING, SPECIFY: WARREN QUIMBY PUMPS

G-2

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

be processed to meet the current market. The extraction process does not alter the fertilizer value of the Milorganite, nor does it materially reduce the output of Milorganite. As confirmed in the pilot plant tests, the Sewerage Commission will have the same fertilizer product it did before with the same minimum analyses for plant food ingredients.

A continuous automatic extraction operation can be readily coordinated with the production of Milorganite at the sewerage treatment plant. The new extraction plant would be built to cut into the production line between the conveyor from the present drying room where most of the moisture is removed from the Milorganite and the weighing and bagging area in the storage building where the Milorganite is prepared for shipment.

Conveyor belts are planned for detouring the finished Milorganite fertilizer to the adjacent extraction plant. There it will be moistened with water to prepare it for the continuous extraction process. This is similar to the making of drip coffee except that the extracted Milorganite, unlike spent coffee grounds, is washed many times by constantly weaker solutions of extract to remove all of the valuable material before the continuously washed Milorganite is redried.

The extract solution from the continuous extraction process is evaporated in huge vacuum concentrators using steam to produce a molasses-like syrup of the Vitamin B_{12} concentrate. This syrup is converted to a powder in a spray dryer.

The Vern E. Alden Co., in business since 1942, has designed and built chemical plants, food plants, steam power plants, natural gas pipeline compressor stations, research laboratories, aircraft engine test cells, plants for the manufacture of electrical equipment and other industrial units, principally in the Middle West. Three Chicago area men, Vern E. Alden, Edward R. Albert and F. I. Wennerholm, are senior partners. Robert E. Zinn, senior chemical engineer of the company, is also a professor of chemical engineering at North-

western. He has been assisted in the operation of the pilot plant by Professor William F. Stevens, also a member of the chemical engineering faculty at Northwestern.

Prices Cut 12 Percent on Titanium Mill Products

First significant price reduction for titanium metal mill products, an average cut of more than 12 percent for commercially pure sheet and plate, has been made by the Titanium Metals Corp. of America. Rapidly expanding production and continuous mill rolling of titanium sheet have progressively forced costs downward. These pared costs mean lower prices for consumers of whom the largest are manufacturers of military airframes.

New sheet and plate orders are now being priced at the lower schedule. Further, some $2 million of sheet and plate business currently on the books of Titanium Metals is being immediately repriced downward to extend the new lower prices to all customers.

Cyanamid May Take Over Government NH_3 Plant

American Cyanamid Co. may lease the ammonia plant at the Missouri Ordnance Works, Louisiana, Mo., from the government. Negotiations with the Army are now in progress. American Cyanamid has offered to pay a minimum annual rental of $343,980. This is the best proposal received by the Corps of Engineers, according to Major General Samuel D. Sturgis, Jr., Chief of Engineers.

American Cyanamid has offered to pay the government a rental of $13.23 on each ton of ammonia produced. At peak operation, this could exceed $500,000 a year.

The lease would be for six years, with two six-year renewal options and a right to purchase the plant outright at any time within the first three years at about $3,325,000.

The plant, which produced ammonia for explosives during World War II, has been shut down since

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Corrosion Resistant TEFLON Jacketed Gaskets for glass-lined steel connections, Corning conical flanges, etc. Chemiseal molded TEFLON Snap-on Gaskets for conical-end glass pipe assuring automatic centering of joints and free flow of materials. Chemiseal Adaptors which provide a safe, tight seal between conical-end glass pipe, glass-coated steel or similar nozzles of large inside radii and vessels of glass-lined steel, porcelain, Haveg, etc.

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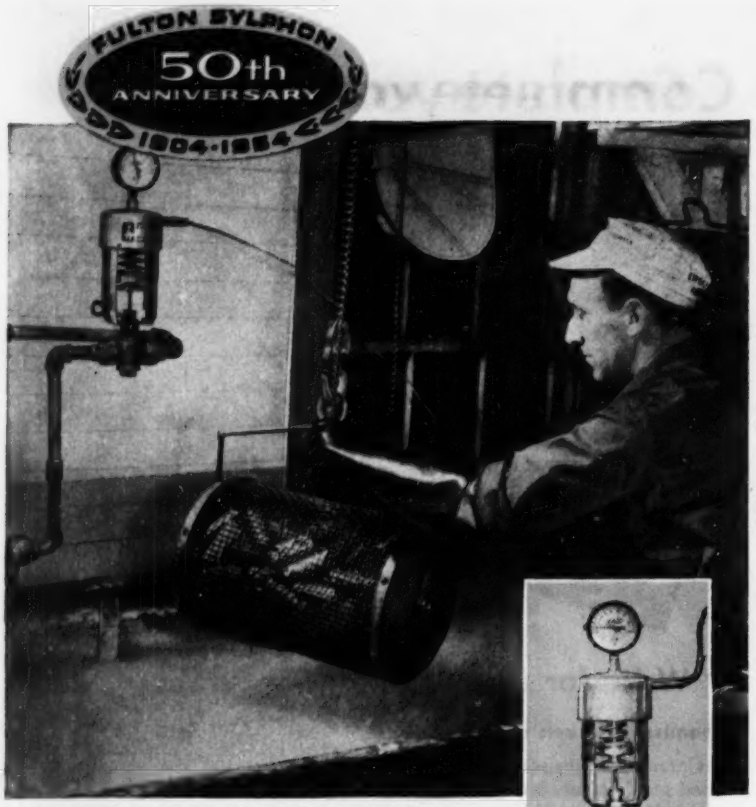
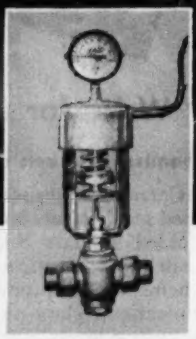


Sylphon Control No. 999-T, used in bonderizing operation at Modern Tool and Die Co., Cleveland, Ohio.



SYLPHON TEMPERATURE REGULATOR NO. 999-T — *Powerful, compact, accurate. Can be supplied with or without dial indicating thermometer. Ideal for many temperature control uses.*

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TANKS OF HOT ACID solutions or hot water are real problems where temperature must be controlled manually. Use of hand thermometers is risky, often causes serious injury.

Guess-work methods are avoided completely with Sylphon automatic temperature controls. The coating operation shown above is typical. Installed in the steam line, the Sylphon Control automatically assures *constant* temperature of the coating solution. Time-wasting, risky checking is out.

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CONTROLS COMPANY

FULTON SYLPHON DIVISION • **KNOXVILLE 1, TENN.**

WHAT'S HAPPENING . . .

June 1953, when the Bureau of Mines ended its experiments on synthetic fuels from coal.

Located on a 403-acre site in Pike County, about 75 mi. north of St. Louis, the plant was built in 1941. It has a maximum capacity of 105 tons of ammonia daily.

Gum Turpentine: Source Of Organic Peroxides

A fast, straightforward process for the economical production of pinane hydroperoxide from gum turpentine has been developed by the Department of Agriculture's Naval Stores Station at Olustee, Fla. If used commercially, it could make pine gum a source of organic peroxides for use as polymerization catalysts in the production of synthetic rubber, resins and plastics.

Terpene peroxides produced from gum turpentine in earlier research were successful when tested by the Office of Rubber Reserve as polymerization catalysts in the production of cold rubber. But a practical method was needed for commercial operation.

Several chemical companies are interested in making pinane hydroperoxide and other turpentine peroxides. These could, in an emergency, replace cumene hydroperoxide, a benzene compound, as commercial catalyst in cold rubber production.

Four main steps are involved in the process, according to G. S. Fisher, who helped to develop it. Turpentine is first hydrogenated to give pinane; next the pinane is purified, usually by simple distillation; then the pinane is oxidized with molecular oxygen to a peroxide content of about 50 percent; finally the oxidate is stripped under vacuum to recover the unoxidized pinane, leaving the pinane hydroperoxide as a residue.

Starting with 8-lb. batches of turpentine, Fisher says, this process yields 4-lb. batches of peroxides about 80 to 90 percent pure. In pure form, pinane hydroperoxide is cis-l-pinane 2-hydroperoxide.

Development of new products

from components of gum turpentine would open new markets for pine gum, which needs stabilization against rising competition from new chemical industries. Production of hydroperoxides from gum turpentine would represent a large outlet.

Use of turpentine hydroperoxides in the manufacture of about 700,000 tons of synthetic rubber, for example, would require about 300,000 gal., which is 2 million pounds, of gum turpentine.

Components of turpentine are primarily terpene hydrocarbons having 10 atoms of carbon and 16 atoms of hydrogen. In American gum turpentine about 95 percent of the components are *alpha*- and *beta*-pinane; remaining constituents are other terpenes and other compounds. These components offer opportunities for new industrial products.

Solvay to Barge Products From Moundsville Plant

Products from its new Moundsville, W. Va., plant will be shipped by Solvay Process Division, Allied Chemical & Dye Corp., by barges along the Ohio River and its tributaries.

A dock for loading barges will shortly be completed at the Moundsville plant. It is being built by Pihl & Miller of Pitttsburgh, Pa.

Solvay's Moundsville plant, now producing chlorine and caustic, is expected to start turning out methyl chloride, methylene chloride, chloroform and carbon tetrachloride in mid-summer. Units for their manufacture are currently under construction.

The new dock will also be used to ship products from Solvay's associate, National Aniline Division, which recently went into production of nitrobenzene and aniline at its Moundsville plant. Maleic anhydride and fumaric acid will be produced later.

The new barge facilities will also be used by both the Solvay and Aniline plants to receive raw materials. —*End*

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When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology

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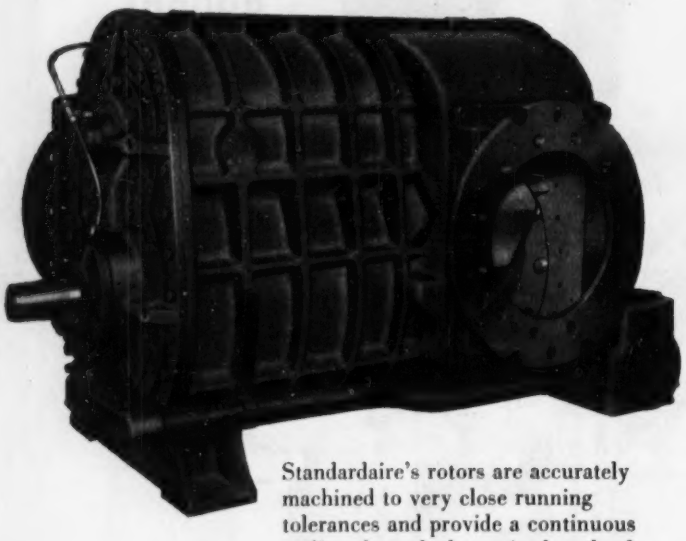

Standardaire's rotors are accurately machined to very close running tolerances and provide a continuous sealing through the entire length of their engagement. Thus, the high pressure gas or air is confined at the discharge end of the Blower and leakage lines are much shorter than on other types of units.

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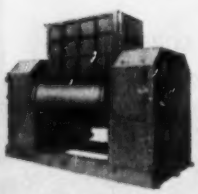

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THIS MONTH'S

Technical

Stepchild

CHEMISTRY OF THE LANTHANONS. By R. C. Vickery. Academic Press, Inc., New York. 296 pages. $6.

Reviewed by F. C. Nachod

The rare earth elements have been a challenge to the chemist for more than 200 years. Even though in the light of Bohr's theory and Planck's quantum mechanics, the chemistry of the expanding N shell group can now be understood, the subject matter is rarely covered in the university curriculum and only an occasional graduate inorganic course covering the elements 57 to 72 will be encountered.

The present book written by an Australian scientist of repute will thus be welcomed as a report on this rather complex and perplexing field which has been treated much like a stepchild.

As may be expected, a large portion of the book (8 chapters) deals with separation procedures. Here it is perhaps regrettable that so much emphasis has been put on such methods as crystallization and precipitation, while the ion exchange separation work which has been so eminently successful in the hands of the Ames group under Dr. Spedding, is relagated to only about 8 pages. Yet this elegant

Recent Books Received

The Actinide Elements. Ed. by Glenn T. Seaborg & J. J. Katz. McGraw-Hill. $11.75.

Catalysis. Vol. I. By Paul H. Emmett. Reinhold. $10.

Experimental Inorganic Chemistry. By R. E. Dodd & P. L. Robinson. Elsevier. $6.50.

Fresh Water From the Ocean. By Cecil B. Ellis. Ronald. $5.

Handbook of Standard Time Data. By A. A. Hadden & V. K. Genger. Ronald. $10.

Materials & Processes. By James F. Young. Wiley. $8.50.

Organic Coating Technology. Vol. I. By H. F. Payne. Wiley. $10.

Quantitative Organic Analysis Via Functional Groups. 2nd ed. By S. Siggia. Wiley. $5.

Bookshelf

L. B. Pope

technique has provided rare earth compounds in pound quantity with a purity of better than 99.9 percent!

Aside from this minor shortcoming the "Lanthanons" is a scholarly, well written discourse, particularly suited for an advanced inorganic class topic. Historians of chemistry will find much interesting matter in the introductory chapter, and spectroscopists and physical chemists will use the book as ready reference.

Theory and Technology

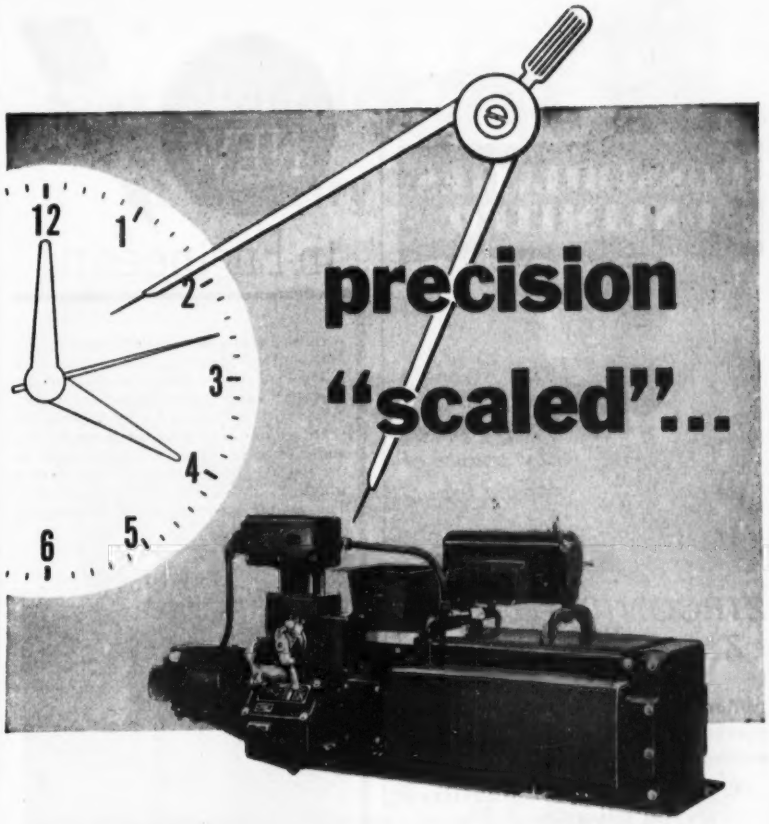
SOAP MANUFACTURE. Vol. I. By A. Davidsohn, E. J. Better and J. Davidsohn Interscience Publishers, Inc. New York. 525 pages. $12.50.

Reviewed by Gordon W. McBride

First half of a two-volume monograph is devoted to theoretical principles underlying various soap processes which are described in subsequent chapters of the volume. Raw materials are also considered in this volume. (Vol. II is expected to appear shortly, describing equipment and operations from the soap-boiling stage to the final product. Byproduct glycerine recovery, analytical controls, laboratory soap-making, and other miscellaneous subjects will complete the work.)

This book is an attractive addition to the Fats and Oils Series. The type is a little smaller than comfortable for easy reading and the theoretical considerations with which the book opens are not conductive to light reading. Liberal use of tabular information, however, will make the book a frequently used reference volume.

Subject matter is presented in a logical manner. Although there may be some room for argument about theories which are set forth and mechanism of some of the reactions, the book should be well received throughout the fats and oils industry. —*End*



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Minute to minute accuracy in the feeding of dry materials — uniform delivery to reaction tanks, continuous blending, or batch mixing — is a requisite for maintaining uniformly high quality in final products, in modern chemical processing operations.

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1. Very high melting point at 4700° F.
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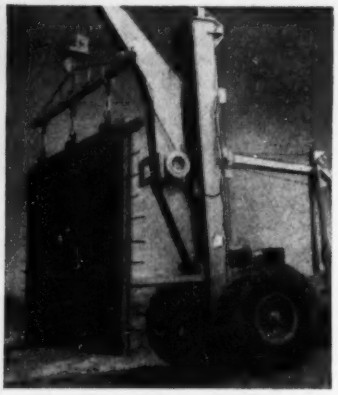
what's NEW in Engineering

A carbon dating process developed by the University of Manitoba is said to make it possible to date – within 10 years of actual age – any matter containing radioactive carbon from as far back as 40,000 years. A liquid scintillator is used. The material to be dated is incorporated in the liquid. There it sets up light flashes which are measured by an electronic eye. The sample is destroyed in the testing process.



Pre-cast, tilt-up walls, soil testing and analysis, uniform spacing of bays and a dead level roof all played important roles in Kaiser Engineers' research, design and construction of Westinghouse's newest – and largest – commercial lighting fixture plant. The result: a building suited in every respect for its intended purpose, and one constructed at an unusually low cost per square foot. For further information on this and other major Kaiser Engineers' projects, write us at the address below.

A cold weather blow torch, weighing just 6½ ounces, is claimed to operate efficiently at temperatures down to –70F. The torch pre-heats its own combustion air and a separate tank supplies fuel.

Widely diversified engineering talents and experience are available to every Kaiser Engineers' project. Departments include civil, structural, electrical, mechanical, architectural, process and production, mining and geology, metallurgical and chemical – and all work closely together. Call or write to Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

THIS MONTH'S

Recent Books

Cr—Mo Steels

A summary of elevated-temperture strength data for chromium-molybdenum steels. Includes curves for tensile strength; percent elongation and reduction of area. An appendix contains primary data from which curves were made. 207 pages.

"The Elevated-Temperature Properties of Chromium - Molybdenum Steels." Oct. 1953. American Society For Testing Materials, 1916 Race St., Philadelphia 3, Pa. $4.75.

Properties of Monel

A booklet of engineering data on cast "S" Monel alloy. Includes low-temperature impact, thermal expansion, compressive strength values. 7 pages.

"Engineering Properties of "S" Monel." Technical Service Section, The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Paper and Paper Products

The various ATSM standards, test methods and definitions of terms on paper, paper products and shopping containers are grouped together in this booklet. 383 pages.

"ASTM Standards on Paper and Paper Products and Shipping Containers." Sept. 1953. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.50.

Tallol

Contains abstracts of theses on investigations into tallol. Much of this work was done at the Virginia Polytechnic Institute. Booklet covers such topics as: composition, refining, esterification and miscellaneous. 14 pages.

"Tallol Investigations." Engineering Experiment Station Series No. 89. Virginia Polytechnic Institute, Blacksburg, Va. 25 c

& Pamphlets

R. B. Norden

Vapor Barriers

A book with illustrations, showing where and how a vaporseal coating should be applied over thermal insulation—for low temperature applications. Manual covers three major classes of insulation and discusses vaporsealing of chemical vessels and fittings. 80 pages.

"Vapor and Weather Barriers for Low Temperature Thermal Insulation." Insul-Mastic Corp. of America, 1141 Oliver Building, Pittsburgh 22, Pa. $5.

Capital Goods Industry

Bulletin documents the size and structure of the American capital goods industry. Broad categories and types of capital goods are discussed on an individual basis. 15 pages.

"Size and Structure of the Capital Goods Industries." Council for Technological Advancement, 120 South La Salle St., Chicago 3, Ill.

Business Statistics

Pamphlet outlines how to go about getting and organizing a low-cost business statistics library. Other reference works are referred to for building a less modest library. 25 pages.

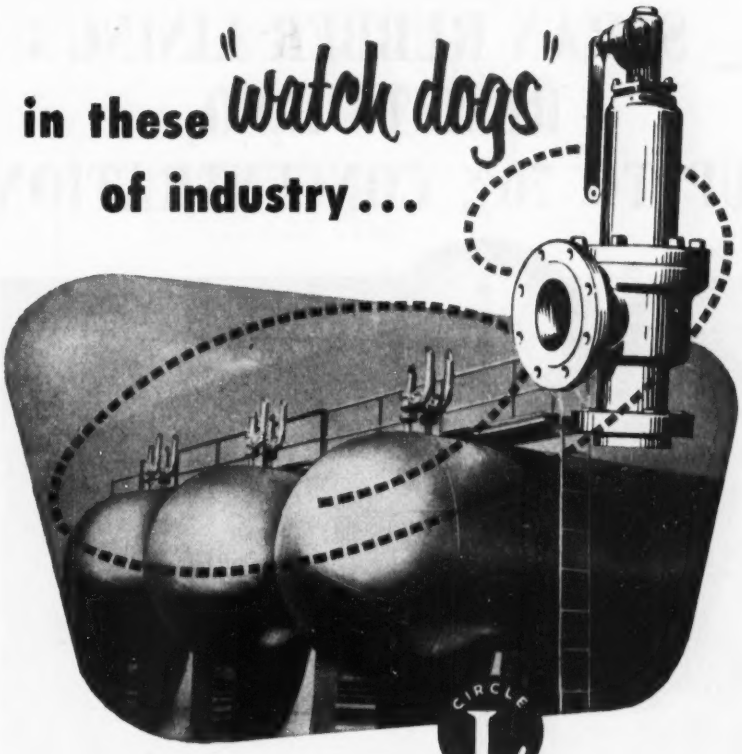
"What's the Answer?" Economic Research Department, Chamber of Commerce of the U. S. Washington 6, D. C. 50 c.

Tin

A symposium on tin presented at the fifty-fifth annual meeting of ASTM. Pamphlet is comprised of 6 papers, ranging from tin production and resources to determination of small amounts of impurities in tin. 116 pages.

"Symposium on Tin." ASTM Special Tech. Pub. No. 141, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.50.

in these "watch dogs" of industry...



LEBANON STEEL Castings are at work

SAFETY valves, those "watch dogs" of industry, are particularly important in chemical, refinery and power plants. Farris Safety and Relief Valves, for instance, are "on guard" 24 hours a day, protecting workers, protecting equipment, and assuring uninterrupted plant operations. Lebanon CIRCLE Ⓛ castings, important parts of these valves, are produced in several special alloys including CIRCLE Ⓛ-17*, a hardenable, corrosion-resistant, stainless steel with exceptional strength at elevated temperatures. Selecting these Lebanon casting materials added greater reliability to Safety and Relief Valves operating in lines handling steam, corrosive fluids and gases. These Safety and Relief Valves are manufactured by the Farris Engineering Corporation, Palisades Park, N. J.

Lebanon's experienced craftsmen produce castings in a wide range of materials . . . flexibility and control that provide truly dependable products.

*Lebanon's designation for Armco's 17-4-PH, produced under license by Armco Steel Corporation.

See—STEEL WITH A THOUSAND QUALITIES—37 min., 16 mm, semi-technical, full-color sound film on the making of steel castings. For information write: Dept. F, Lebanon Steel Foundry.

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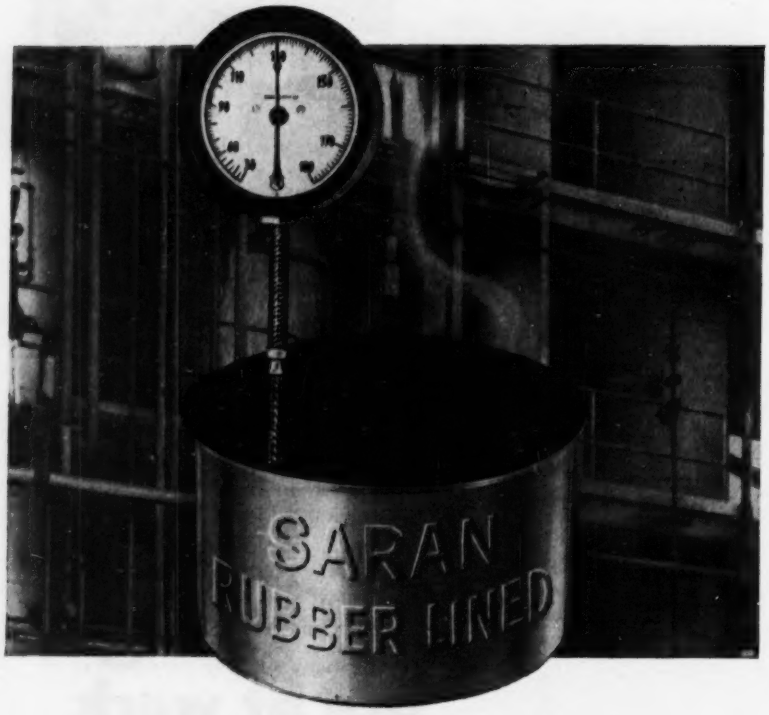
SARAN RUBBER LINING RESISTS H_2SO_4 UP TO 70% CONCENTRATION



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THIS MONTH'S

Firms in

New Facilities

Armour Laboratories. Kankakee, Ill.—A new pharmaceutical center has been completed by the firm, a division of Armour & Co. The various sections of the new unit comprise seven buildings in one. Included are provisions for the departments of aseptic techniques, blood derivatives and parenteral manufacturing, solvent extraction, maintenance and power and general services: warehouse, shipping, packaging and control laboratory facilities. Over-all plant facilities have been designed, functionally, on a one story streamlined level with the greatest emphasis on sanitary treatment. The firm plans to extend its activities in the development of pharmaceutical specialties, especially, the vital gamma globulin.

Process Engineering & Machine Co., Inc.—Factory and office facilities have been opened in Elizabeth, N. J., for the manufacture of condensers, columns, heat exchangers, mixers, and other process equipment and plants.

Robert Gair Co., Inc., New York—The acquisition of Angelus Paper Box Co., Los Angeles, Calif., provides the New York firm with manufacturing facilities in the California area for its paperboard, folding cartons and shipping containers.

Babcock & Wilcox Co., New York—A manufacturing agreement has been concluded between this New York firm and the Seaboard

the News

M. A. Gibbons

Refractories Co., Raritan Township, N. J., by which Seaboard's facilities will be devoted to the production of Babcock's special refractories.

Nuodex Products Co., Inc., Elizabeth, N. J.—A commercial development department has been created to devise methods for the market introduction of new products. The firm manufactures special-purpose chemicals for industry.

Enjay Co., Inc., New York—Establishment of the Enjay Laboratories Div. by Standard Oil Development Co. to provide sales technical service in the petrochemicals industry. Specifically, the unit will concentrate on petroleum additives, solvents, chemicals and polymers.

Richfield Oil Corp., Los Angeles—Four-story addition to its main office building will provide 36,000 sq. ft. of additional space at a cost of $1 million.

National Research Corp., Cambridge, Mass.—A petrochemical laboratory is being constructed on the firm's property in Newton, Mass. The firm is currently engaged in a joint venture with Electric Bond & Share Co. and United Gas Corp. to conduct research and market studies aimed at utilizing natural gas in the development of new chemicals.

The Oilgear Co., Milwaukee—A Chicago office has been opened at 4754 West Washington Blvd. to serve the area with Oilgear's application engineering and component service.

Fram Corp., Providence, R. I.—Liquid-separator production facilities and sales organization have been acquired through the purchase of the Warner Lewis Co., Tulsa, Okla. Liquid sepa-

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announces new line of
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VVF pigments are produced by our unique grinding process to give a *very, very,* fine product controlled for top particle size and particle-size distribution.

VVF pigments will reduce your grinding and dispersing time in paints and allied products as much as 75%.

VVF pigments give you brighter mass color, stronger tint, increased hiding power, and higher gloss than standard grind pigments.

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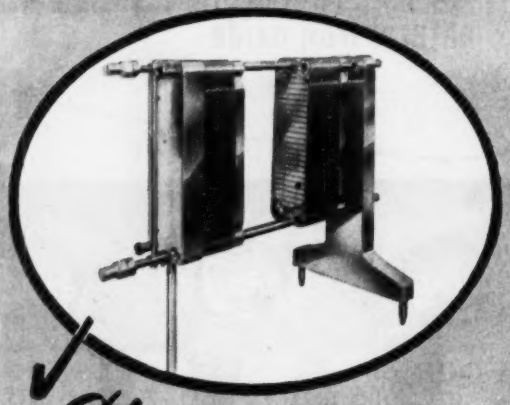

Check THE NEW DE LAVAL PLATE HEAT EXCHANGER

There are an almost unlimited number of industrial process problems to which the new De Laval Plate Heat Exchanger provides the ideal answer. This is true because its basic engineering design, type of construction and operational characteristics give it many inherent advantages over other equipment offered for heating and cooling applications. Some of them are:

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2 Complies with sanitary requirements—designed for "in-place" cleaning.
3 Easy variation of assembly to meet changes in operation—plates are invertible (except Model P5).
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10 Liquid cannot leak from one section to another and cannot become mixed with heating or cooling medium.
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12 Gaskets readily replaceable in user's plant.
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14 Wide range of sizes and capacities.

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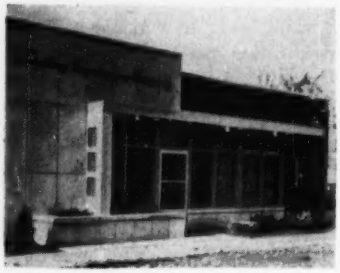
FIRMS . . .

rator filters are employed in the removal of solid contaminants and water from liquid hydrocarbons and commercial solvents.



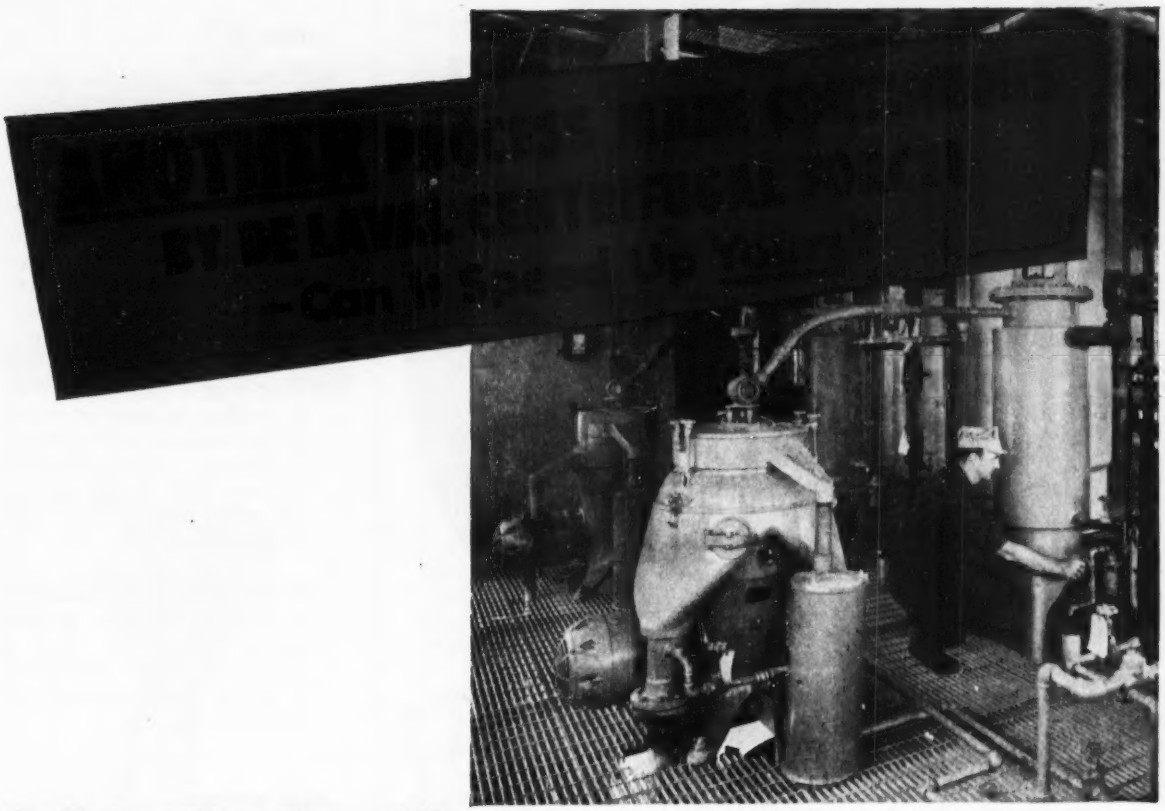
Lindberg Engineering Co., Chicago—Modern offices located in the suburbs, Royal Oak, Mich., for its Detroit office have been opened. The firm manufactures a line of arc and high frequency melting furnaces. In addition, the firm has opened offices in Montreal with the formation of EFCO-Lindberg Ltd.

American Cyanamid Co.—An Organic Chemicals Division has been organized which will merge the activities of the Petrochemicals and the Calco Chemical Divisions. In addition, the Fine Chemicals Division has been formed to handle the domestic sales of bulk antibiotics and pharmaceuticals.

Eastman Chemical Products, Inc.—A sales office in Cincinnati, Ohio, has been opened by this subsidiary of the Eastman Kodak Co. Previously, the district now served by the new office was handled by the firm's headquarters in Kingsport, Tenn.

Parke, Davis & Co.—Warehouse and office facilities in Philadelphia to provide more efficient distribution of the firm's pharmaceuticals. The new depot occupies some 40,000 sq. ft. of land and provides off-street parking facilities.

Perry Equipment Corp., Philadelphia—A Chicago branch office has been opened to serve Midwest consumers of Perry's stock



Refining Rice Bran Oil

The production of rice bran oil can be speeded up very effectively by using De Laval centrifugals at two points in the refining process. One De Laval machine, the Soapstock Separator, removes the soap and waxes from the oil. Another type of De Laval centrifuge separates out excess alkali and other impurities.

For many years De Laval machines have been used to refine vegetable oils. Rice bran oil separation is merely a logical extension of this experience. It is one more example of how a De Laval centrifuge can save time and money by speeding up a process.

Usually, centrifugal separations are quite easy; in some cases, De Laval machines will break emulsions that are too tight to break by other means.

● Why not tell us of ***your*** problem.

THE DE LAVAL SEPARATOR COMPANY Chicago POUGHKEEPSIE San Francisco

DE LAVAL FOR FASTER PROCESSING SYSTEMS

The "Entoleter" Impact Mill can assure you complete dispersion . . . compact installation . . . simplified maintenance . . . and will process up to 25 tons per hour!!!

Whether you use

$$\gamma = \frac{2.3 \log_{10} \frac{I_o}{I_n}}{t}$$

to determine the efficiency of your color dispersion or not . . . we know you can get maximum . . .

Intensity

Extension

Uniformity

with the "Entoleter" Impact Mill. May we process a sample of your product for your evaluation?

The trademark "ENTOLETER" is your guarantee of complete satisfaction

ENTOLETER DIVISION
The Safety Car Heating and Lighting Company, Inc.
1185 Dixwell Ave. New Haven 4, Connecticut

FIRMS . . .

of used and surplus new processing equipment for the chemical, drug and allied industries.

Watson-Stillman Div., H. K. Porter Co.—A $250,000 expansion of plant and manufacturing facilities at the division's headquarters in Roselle, N. J., for the production of forged steel fittings.

American Latex Products Corp., Hawthorne, Calif.—A 30,000 sq. ft. building to house production of its foamed plastic product "Lockfoam." The firm also manufactures foam rubber and special rubber by-products for commercial industries.

Carbide Dioxide & Chemical Co.—A $150,000 expansion of facilities at its carbonics plant in Wellington, Utah. Production of dry ice will be increased from 40 to 75 tons daily.

New Services

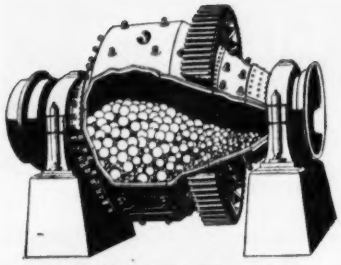
Truesdail Laboratories, Inc., Los Angeles, Calif., has established a research advisory board of internationally-known scientists to specialize in the practical industrial problems encountered in the drug, paint and plastics industries.

New Representatives

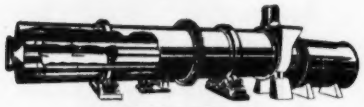
American Water Softener Co., Inc., Philadelphia, Pa., manufacturers of water conditioning and waste treatment equipment has appointed American Water Softener Sales Co., New York, as exclusive representative in metropolitan New York.

Badger Mfg. Co., Cambridge, Mass., will now be represented in Cincinnati by the Kenneth B. Little Co., 200 Brotherhood Bldg., of that City. The latter firm will handle Badger expansion joints.

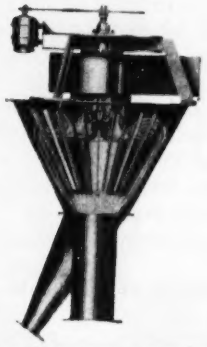
The Glidden Co., Naval Stores Div., through its exclusive selling agent—the E. W. Colledge, G. S. A., Inc., Jacksonville, Fla.



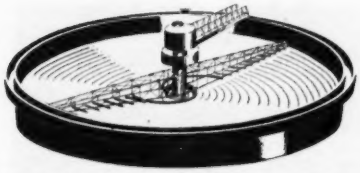
CONICAL & TRICONE MILLS



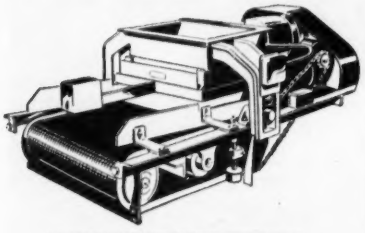
ROTARY DRYERS
KILNS, COOLERS



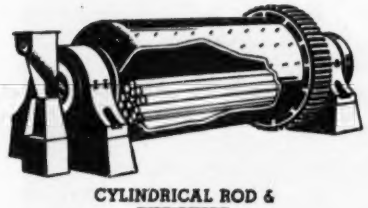
"GYROTOR" AIR CLASSIFIER



"AUTO-RAISE" THICKENERS, CLARIFIERS



CONSTANT-WEIGHT FEEDERS



CYLINDRICAL ROD &
BILL MILLS

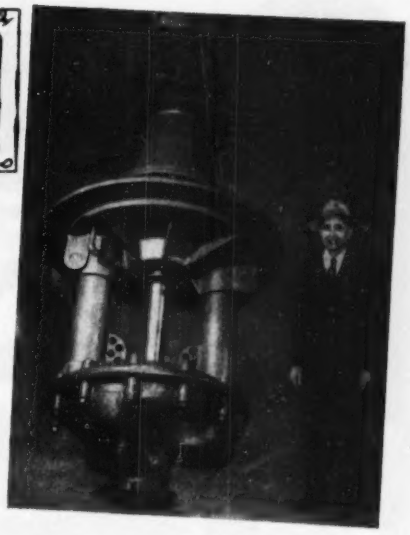
HARDINGE
COMPANY INCORPORATED
YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works
New York • Toronto • Chicago • Hibbing • Boston • Salt Lake City • San Francisco

WANTED!

PUMPING JOBS NOBODY ELSE WANTS!

You can buy lots of good pumps for ordinary pumping jobs, but NAGLE PUMPS are built to survive in those applications where ordinary pumps fail.

If you must pump highly abrasive mixtures, corrosive liquids, hot solutions or heavy slurries, then you will save by using NAGLE CENTRIFUGAL PUMPS. Engineered to your specific requirements—The right design, the right materials of construction. Horizontal and vertical shaft types in complete range of sizes. Send for Catalog 5206.



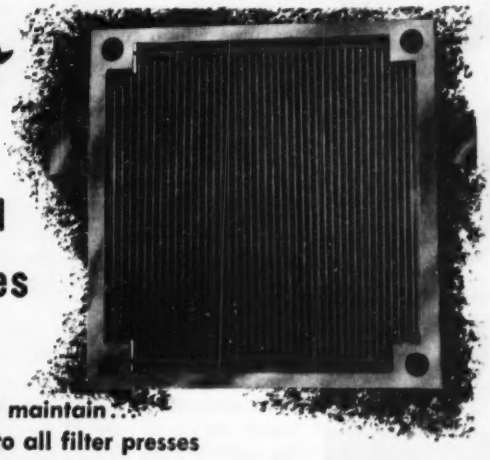
• Modified type "SW-O" vertical shaft pump built by Nagle for severe service in an atomic energy plant.

NAGLE PUMPS

NAGLE PUMPS, INC.
1235 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

a *New* filter plate for plate and frame presses



- strong yet light...
- easy to handle...
- easy to clean and maintain...
- easily adaptable to all filter presses

"MULTI-PLATE"

A new, unique, thoroughly proven filter plate with worthwhile advantages. Strong—yet much lighter, hence, easier to handle; from 40 to 80% lighter than cast plates of same size. Because it is made of sheet metal and bar stock of any desired alloy, it has a smooth surface; resists corrosion better; is easier to clean, wash, steam and sterilize.

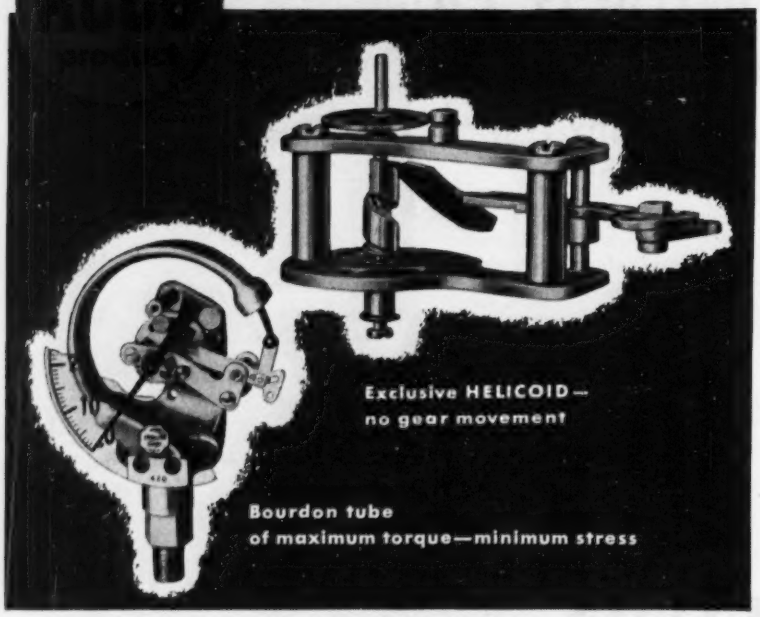
Multi-Plates are especially suitable for delicate or sensitive chemicals, dyes, pharmaceuticals and kindred materials.

Multi-Plates are available in flush plate, washing or non-washing type, open or closed discharge; also in recessed type; may be used with any textile or metallic filter cloth.

Write for Bulletin 541.

MULTI-METAL WIRE CLOTH CO., INC.
1353 GARRISON AVENUE • NEW YORK 59, N. Y.

Helicoid Gages

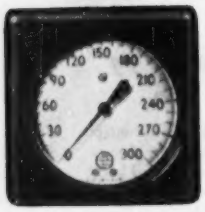


Why HELICOID Costs Less Per Gage, Per Year

HELICOID Gages have many unique and exclusive features which result in enduring accuracy and savings in maintenance cost. They cost less per gage, per year.

Only HELICOID Gages, for instance, have the Helicoid Movement . . . a simple cam and roller design which has no gear teeth to wear out. Bourdon tubes used in HELICOID Gages are carefully designed to give maximum torque and minimum stress . . . promoting the greatest possible endurance life. They withstand many millions of pressure pulsations without stretching, leaking or cracking.

There is a HELICOID long-life gage to meet every type of pressure control requirement. Pressure ranges to 20,000 psi, vacuum or compound. Dial sizes: 3½", 4½", 6", or 8½". Dials may be black, white or radiant faces. They are supplied for wall or stem mounting, flush or panel mounting, or flangeless.



All HELICOID Gages are fully guaranteed. They are time-tested and proved in years of hard service. They assure the highest degree of gage accuracy and long-life service.

Write **TODAY for the G-2 HELICOID Gage Catalog**

ACCO

Helicoid Gage Division

AMERICAN CHAIN & CABLE

927 Connecticut Avenue • Bridgeport 2, Connecticut

FIRMS . . .

—has appointed the O. Hommell Co., Pittsburgh, and the B. H. Roettker Co., Cincinnati, as sales representatives.

Kewannee-Ross Corp., Kewanee, Ill., will be represented in the St. Louis territory by the Debco Equipment Co., Inc., 6219 Delmar Blvd.

Sims Pump Valve Co., Hoboken, N. J., has chosen Nutmeg Industrial Supplies, Inc., as exclusive distributor of Sims inclined port rotating pump valves and other products in Connecticut.

Penn Industrial Instrument Corp., Philadelphia, has selected Snyder Co., Tulsa, Okla., specialists in flow, temperature and pressure control instruments and valves as representative in Oklahoma.

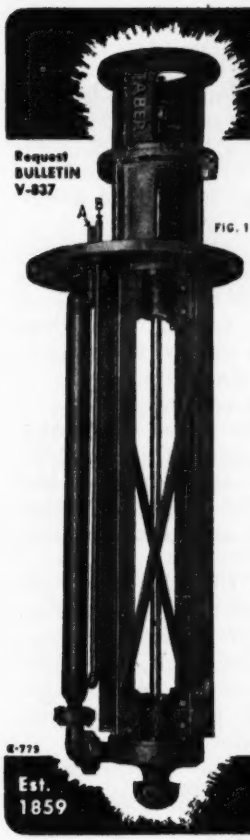
De Laval Steam Turbine Co., Trenton, N. J., has selected La Casa Castro, San Salvador, El Salvador, C. A., to handle De Laval's steam turbines, centrifugal pumps, IMP pumps, compressors and blowers.

Reynolds Metals Co., Louisville, Ky., has named the Turner Metal Supply Co., Huntington Park, Calif., as distributor of Reynolds aluminum wire, rod and bar products.

Universal Detergents, Inc., Long Beach, Calif., has appointed the Paul Wiemer Co., Cincinnati, as distributor for its Udet and Udex surface active agents in that city.

The Woburn Chemical Corp., Harrison, N. J., has appointed the T. F. Gowdy Co., New York, as sales representatives for its fatty acids and Isoline (dehydrated castor oil) products.

Hapman Conveyors, Inc., Kalamazoo, Mich., has appointed the Canadian Vickers Ltd., Montreal, as Canadian manufacturers and distributors of Hapman patented sealed-pin chain tubular conveyors. *(Continued)*



Request BULLETIN V-837

FIG. 19.478

for Pumping SULPHUR

This TABER steam jacketed, Vertical Pump was designed to handle molten sulphur. Note the massive construction. Supporting the suspended pump from channel steel permits the use of an open shaft. This is especially desirable for molten sulphur.

Steam jacketed discharge pipe keeps molten materials from solidifying.

Pump operates efficiently at the relatively slow speed of 1750 r.p.m. (We consider 3600 r.p.m. prohibitive because molten sulphur has no lubricating properties.)

Write us the Head, and gpm you wish to handle together with the depth of your sulphur pit, and we shall send further information, with BULLETIN V-837.

TABER PUMP COMPANY
294 ELM STREET • BUFFALO 3, N. Y.

Est. 1859

TABER PUMPS

SPRACO NOZZLES

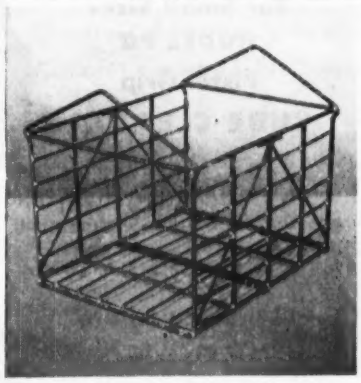
Write for NOZZLE CATALOG to

SPRAY ENGINEERING CO.

115 CENTRAL STREET • SOMERVILLE 45, MASS.

CAMBRIDGE offers you

COMPLETE SERVICE on METAL SPECIALTIES



Crates, trays, baskets, racks, grids —designed and built for your specific materials handling, heat-treat and corrosion resistant end use.

DESIGN

Our Engineers treat your problem as an individual one. We can prepare specific designs to solve it or we will plan production to meet your own designs. Articulated or welded—we are prepared.

FABRICATION

Our shop facilities have simplified production and minimized the human error. We fabricate to prescribed methods.

Let us tell you about our welded and articulated structures. We work in all alloys, on any quantity. We're in the classified section of your telephone book, listed under "Baskets-Wire".

WRITE TODAY for your free catalog describing Cambridge Metal Specialties.

The Cambridge Wire Cloth Co.
Dept. G • Cambridge 4, Md.

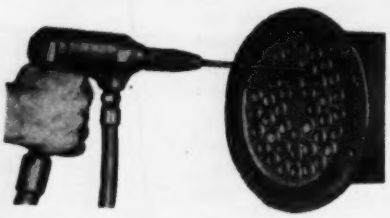
WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

OFFICES IN LEADING INDUSTRIAL AREAS

It's a cinch to clean any size heat exchanger tube the Wilson way!

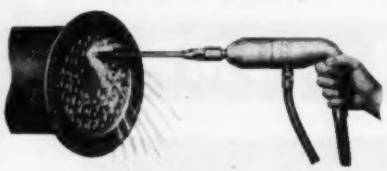
Why put up with the delays and the high costs of makeshift tube cleaning methods? Wilson has exactly the tube cleaner you need to do the job quickly, thoroughly, economically. Wilson's complete line of fast-acting tube cleaners includes the popular PG for ⅜" to 1", the PGX for intermediate sizes ½" to 1½", and the TP-301 for up to 2⅞" ID.

For Small Sizes
MODEL PG
Pistol Grip
TUBE CLEANER



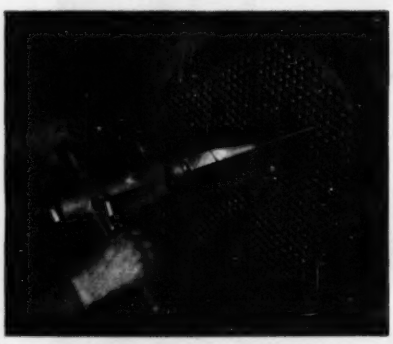
The fast, efficient Pistol Grip Tube Cleaner provides the operator with one-hand control for cleaning small, straight tubes. Weighs only 3 lbs—no more than a 12" Stillson wrench.

For Intermediate Sizes
MODEL PGX
TUBE CLEANER



Positive drive (not geared down) high speed, rotary shaft, air-driven scavenger type cleaner. Washes out tube and debris as it cleans, keeping drill bit cool at the same time. For either vertical or horizontal applications, straight or curved tubes.

For Heavy-Duty Service
MODEL TP-301
TUBE CLEANER



Suitable for vertical or horizontal use in straight or curved tubes ⅜" ID to 2⅞" ID and up to 40' long. Cleans rapidly, thoroughly, operating at high speed at 90 psi. Can run on pressure as low as 50 psi.

WRITE FOR BULLETIN TW-829

Representatives in all principal cities

Thomas C. Wilson, Inc., 21-11 44th Avenue, Long Island City 1, N. Y.
Cable address: "Tubeclean" New York

WILSON

TW: 856A

TUBE CLEANERS · TUBE EXPANDERS

FIRMS . . .

Carlon Products Corp., Cleveland, Ohio, has chosen the Joseph T. Ryerson & Son, Inc., steel service organization, as distributor for its plastic pipe and fittings.

El Dorado Oil Works, manufacturers of coconut oil fatty acids and methyl esters, has appointed the H. Reisman Corp., New York, as exclusive representative in New England.

Insul-Mastic Corp. of America, Pittsburgh, has chosen the C. W. Poe Co., Cleveland, to sell and apply Insul-Mastic protective coatings in northeastern Ohio.

Michigan Chemical Corp., St. Louis, Mich., has appointed the Wyandotte Chemicals Corp., Wyandotte, Mich., as its exclusive distributor of Pestmaster technical grade DDT in the U. S. and its territories.

New Names

Agricultural Chemicals Service Co., Richmond, Calif. will now be known as the United Fertilizer Co., to describe more accurately its services in the distribution of commercial fertilizers.

Strosacker's Research Dept., Dow Chemical Co., has been renamed the Polychemicals Research Dept. to serve as a better description of the research and development work being performed in saran and styrene polymerization.

E. I. du Pont de Nemours & Co. has adopted the trademarks "Karmex" and "Telvar" for the agricultural herbicide and industrial weed killer formulations of its urea herbicide compounds.

New Locations

Consolidated Chemical Industries, Inc., has moved its New York offices from 630 Fifth Ave. to 380 Madison Ave.

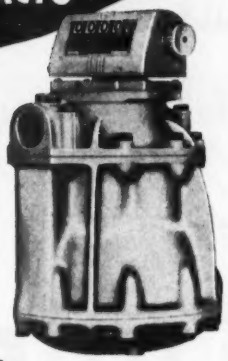
Conneaut Rubber & Plastics Co., has moved its sale offices from Tallmadge, Ohio, to its plant

YOU NAME THE LIQUID . . .

BOWSER

WILL MEASURE IT WITH XACTO

. . . "the meter that changed chemical processing habits"!



For over a quarter century Bowser Xacto meters have brought to the chemical industry an entirely new way to measure liquids accurately and dependably.

Wherever accurate measurement is essential to assure uniformity of product and control costs . . . there you will usually find Bowser Xacto meters on the job.

Today XACTO meters are handling these and 638 other liquids. . . .

Acetic Anhydride	Amyl Acetate	Carbolic Acid	Iso-Propyl Acetate
Alum Solution	Anhydrous Ammonia	Cellosolve Acetate	Lactic Acid
Ammonium Chloride	Aqueous Ammonia	Copper Nitrate	Napthenic Acid
Ammonium Nitrate	Arsenic Acid	Copper Sulphate	Resin Alkyd
Ammonium Phosphate	Butyl Acetate	Cresol	Stearic Acid
Ammonium Sulphate	Calcium Bisulphite	Cresylic Acid	Tannic Acid

MAY WE SEND COMPLETE DATA?

BOWSER, INC., 1375 Creighton Avenue, Fort Wayne 2, Ind.

BOWSER — Regional Offices • Atlanta • Chicago • Cleveland • Dallas • Kansas City • New York • San Francisco • Washington, D. C. • Hamilton, Ont.

NEW! Atkomatic SOLENOID Cast Iron and Cast Steel Valves

ATKOMATIC's new line of cast iron and cast steel valves offer greater range of applications as well as new engineering principles. Internal design features compensate for expansion under heat, prevent sticking. Stainless steel hooded pilot seat screw permits more positive closing action. New design permits pressures to 1000 P.S.I. at 200° F., 500 P.S.I. at 450° F. Teflon disks inert to all media except hot fluorine are used. Removable inserts are used throughout complete range of sizes.

Available in sizes ½ through 2 inches.

Write for Technical Bulletin No. 106 for more complete information

Atkomatic SOLENOID ELECTRIC VALVES

ATKOMATIC VALVE COMPANY
555 ABBOTT STREET INDIANAPOLIS 25 INDIANA

NEW PENNSALT FURAN CEMENT

A Fura-Tone® Product
mfg. under Pat. Nos. 2,461,510 & 2,600,764

Greatest Advance in Resin-Cement Chemistry in Ten Years!

Pennsalt Furan Cement combines all the advantages of ordinary furan-type cements with many desirable new ones it alone can claim—yet costs no more. This new product supersedes other products as the most versatile general-purpose cement for bonding acid-proof brick or tile in construction of corrosion-resistant linings, floors, and trenches.

Based on a furfural-ketone resin, New Pennsalt Furan Cement is basically different from the furfuryl-alcohol types in common use. Like them, it is stable enough to be stored indefinitely, and does not cause dermatitis. But on all the following points it is clearly superior:

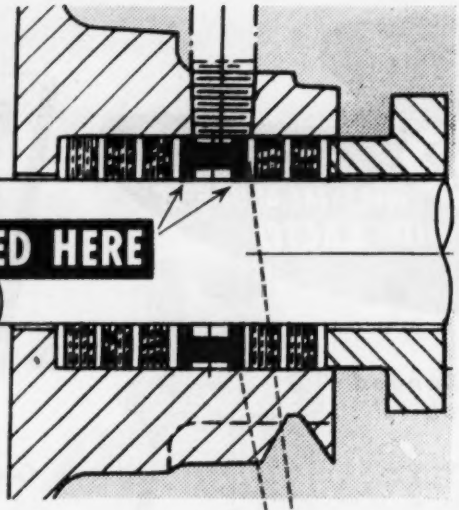
1. An actual, workable 2-to-1 powder-solution ratio.
2. Increased acid resistance.
3. Increased alkali resistance.
4. Increased resistance to most solvents.
5. Longer working life.
6. Easier handling characteristics—less "temperamental" or "hot."
7. Choice of powders—Powder C (carbon filler) and Powder S (siliceous filler).
8. Economical to buy and use—costs no more than common furan-type cements.

To give speedy service, Pennsalt has stocked this cement at many points throughout the nation. Pennsalt Corrosion Engineers are ready to offer technical aid on the product's use. For further information, write: Corrosion Engineering Dept., Pennsylvania Salt Manufacturing Company, 500 Widener Building, Philadelphia 7, Pa.

Fura-Tone is a trademark of Irvington Varnish & Insulator Division of Minnesota Mining & Manufacturing Company

Pennsalt Chemicals

THE LIFE OF YOUR PUMP SHAFT IS DETERMINED HERE



CHEMPRO TEFLON SEAL CAGES

for lubricating or cooling stuffing box packing

Flexible Chempro Seal Cages do not score the shaft as do two-piece metal lantern rings or other types of metal seals. They save the expense of replacing badly scored shafts in pumps and other processing equipment operating continuously at high speeds.

Machined in a single piece, Chempro Seal Cages snap easily over the shaft and *fit snugly.* No chance of movement or vibration even at very high shaft speeds. Their tough construction prevents bending or collapsing under extreme gland pressure.

For corrosive service, they are unbeatable – lasting many times longer than metal rings. They withstand continuous contact with acids, organic solvents, thionyl chloride, etc. – at normal and elevated temperatures.

Chempro Teflon Seal Cages are made in a wide range of sizes to fit most shaft diameters and stuffing box bores.

Write for complete Chempro Packing and Gasket Catalog.

CHEMICAL & POWER PRODUCTS, INC.

The Original Fabricators of Teflon Packings and Gaskets

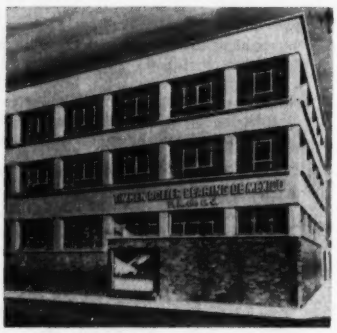
5 Broadway, New York 4, N. Y.

FIRMS . . .

site in Conneaut, Ohio. The firm specializes in custom extrusions of polyethylene and vinyls.

Wolverine Tube Div., Calumet & Hecla, Inc., has moved its sales offices to larger quarters in the Liberty Trust Bldg., Broad & Arch Sts., Philadelphia 7, to serve eastern district consumers.

New Companies



Timken Roller Bearing de Mexico—To handle the sale of products manufactured by The Timken Roller Bearing Co., Canton, Ohio. Sales offices and warehouse facilities are located in Mexico City.

Research Ass'n for Plastics—Formed to plan the erection of an institute devoted entirely to research in plastics. The financial backing for the project will be shared jointly by governmental agencies and private industry.

Paramount Chemicals Ltd.—A new Canadian chemical firm has been incorporated with a capitalization of $10,000. Registered offices of the firm are located at 1001-500 Beatty St., Vancouver, B. C.

Lauren B. Hitchcock—Research and development consulting offices have been opened by Dr. Hitchcock to serve the chemical and food industries. The new offices will be located at 331 Madison Avenue, New York 17.

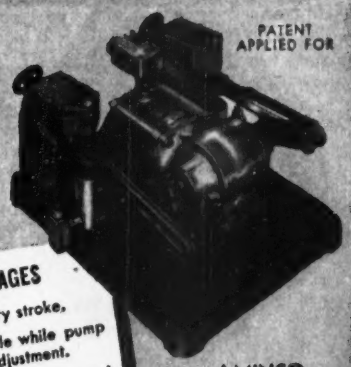
Wallace & Tiernan Inc.—The result of the merger of Wallace & Tiernan Co., Inc. and Novadel-

3 PUMPS IN ONE • 7,500, 15,000 or 30,000 psi working pressure made possible by the interchange of piston and cylinder assemblies in the same pump frame

MICRO-FLEX CHEMICAL PROPORTIONING PUMPS

Simplex and Duplex Styles

PATENT APPLIED FOR



CHECK THESE IMPORTANT ADVANTAGES

1. All liquid in the cylinder is displaced at every stroke.
2. Variable delivery—stroke readily adjustable while pump is running. Locking nut maintains stroke adjustment.
3. Stroke adjustment indicating scale is stationary and legible while pump is running.
4. Stainless steel piston and cylinder assemblies for 7,500, 15,000, and 30,000 psi working pressures are interchangeable in the same pump frame. Simplex and duplex styles.
5. Piston reciprocated by positive mechanical linkage to crank arm—does not rely on return spring.
6. Check valves removed easily for cleaning or replacement.

WRITE FOR BULLETIN 4061-A

AMINCO SUPERPRESSURE PRODUCTS

REACTION VESSELS
VALVES • FITTINGS
TUBING • PUMPS
COMPRESSORS
INSTRUMENTS
DEAD-WEIGHT GAGES
PILOT PLANTS

DESCRIBED IN CAT. 406-A

AMINCO *Superpressure Division*
AMERICAN INSTRUMENT CO., INC.
Silver Spring, Maryland • In Metropolitan Washington, D. C.

STAINLESS fasteners & pipe fittings in STOCK

All types and sizes of screws (hex head, Phillips, slotted, socket), bolts, nuts, washers, rivets, nails and pipe fittings

- Over 9000 items in stock means *immediate delivery* from one source
- New Garden City plant now operating at *top speed and quality*
- Unsurpassed facilities for quantity fabrication of *specials*
- A staff of *seasoned* engineers always available for consultation
- *Pioneers* in the manufacture of stainless steel fasteners

WRITE NOW FOR FREE COPY OF FASTENER MANUAL P6

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ALLMETAL
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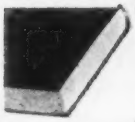

SILICONES and THEIR USES

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For engineers, designers, and all who use or can use silicones, this engineering-slanted manual provides a correlated source of the available information on properties, preparation, and applications of silicones — treated as non-technically as possible. It covers all the commercially available silicone products . . . lists industries and uses they make of silicones, plus cost considerations . . . outlines history of silicone development, its possible uses in medicine and pharmacy, and the elementary chemistry of preparation of silicones from raw material to finished product. **By Rob Roy McGregor, Administrative Fellow, Mellon Inst. 302 pp., 29 illus., 31 tables, $6.00**

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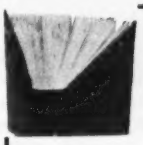

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A reference of industrial know-how on the fundamentals and means of achieving better product quality at lower cost. Use it for basic or advanced review of all phases, not only the statistical, of the quality-control function—for quick reference to many formulas, data, record forms, and other practical information. Covers economics of quality control; organization for quality; acceptance, control, and assurance of quality; application to specific processes and products. **Edited by J. M. Juran, Consulting Management Engineer. 768 pages, 6x9, 176 illus., $12.00**

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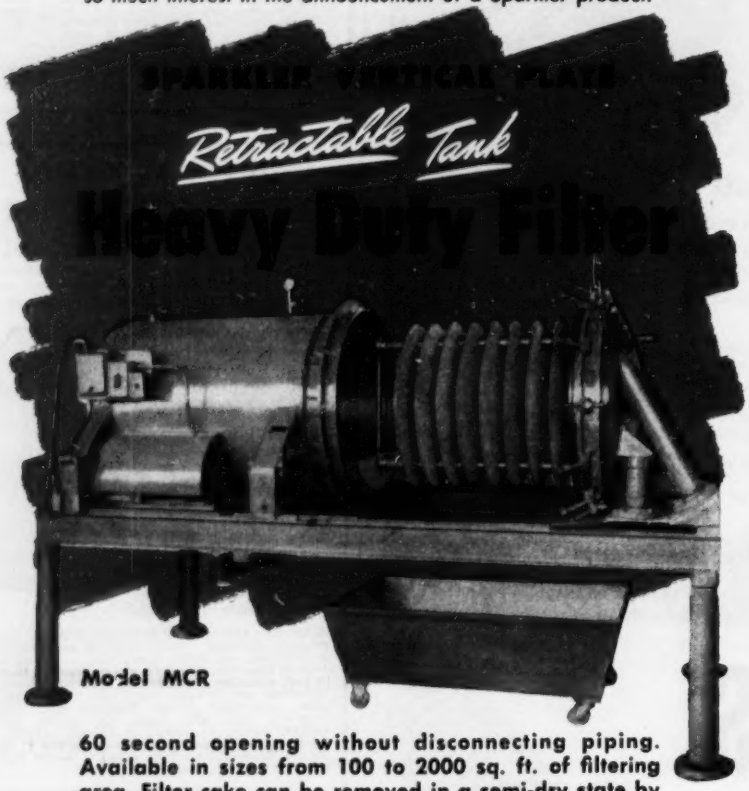

60 second opening without disconnecting piping. Available in sizes from 100 to 2000 sq. ft. of filtering area. Filter cake can be removed in a semi-dry state by hand scraping or in some cases merely tapping the plates to let the cake fall into the portable disposal receptical.

One man can handle the complete cleaning operation in ten minutes. One movement of a handle to release head bolts, a flip of a switch and the tank moves back, stopping automatically, exposing the plates in less than 60 seconds. Pipe connections are all in the stationary head, so no disconnecting of piping is required. This gives you the fastest action, time-saving, labor-saving tank opening ever engineered in a filter.

Jet pressure spray tubes can be supplied in this filter for washing off cake or in combination with backwashing when the material filtered and sewer conditions permit this type of cleaning.

Filter tanks can be supplied in mild steel, stainless steel, Hastelloy or other metals to meet requirements.

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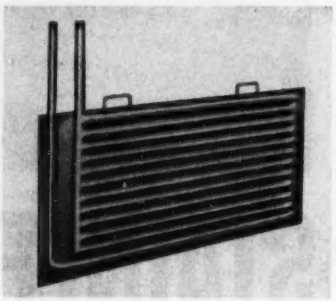
FIRMS . . .

Agene Corp. will combine the former company's equipment, engineering and pharmaceutical lines with the Novadel chemical lines. The new firm will produce various chlorinators, chemical feeders and materials handling equipment.

Taylor Instrument Co. Pty. Ltd.—New Australian subsidiary of the Taylor Instrument Co., Rochester, N. Y., will offer to instrument users in the industrial process fields a complete service including sales, repair and manufacturing. Taylor operates a similar subsidiary in Toronto.

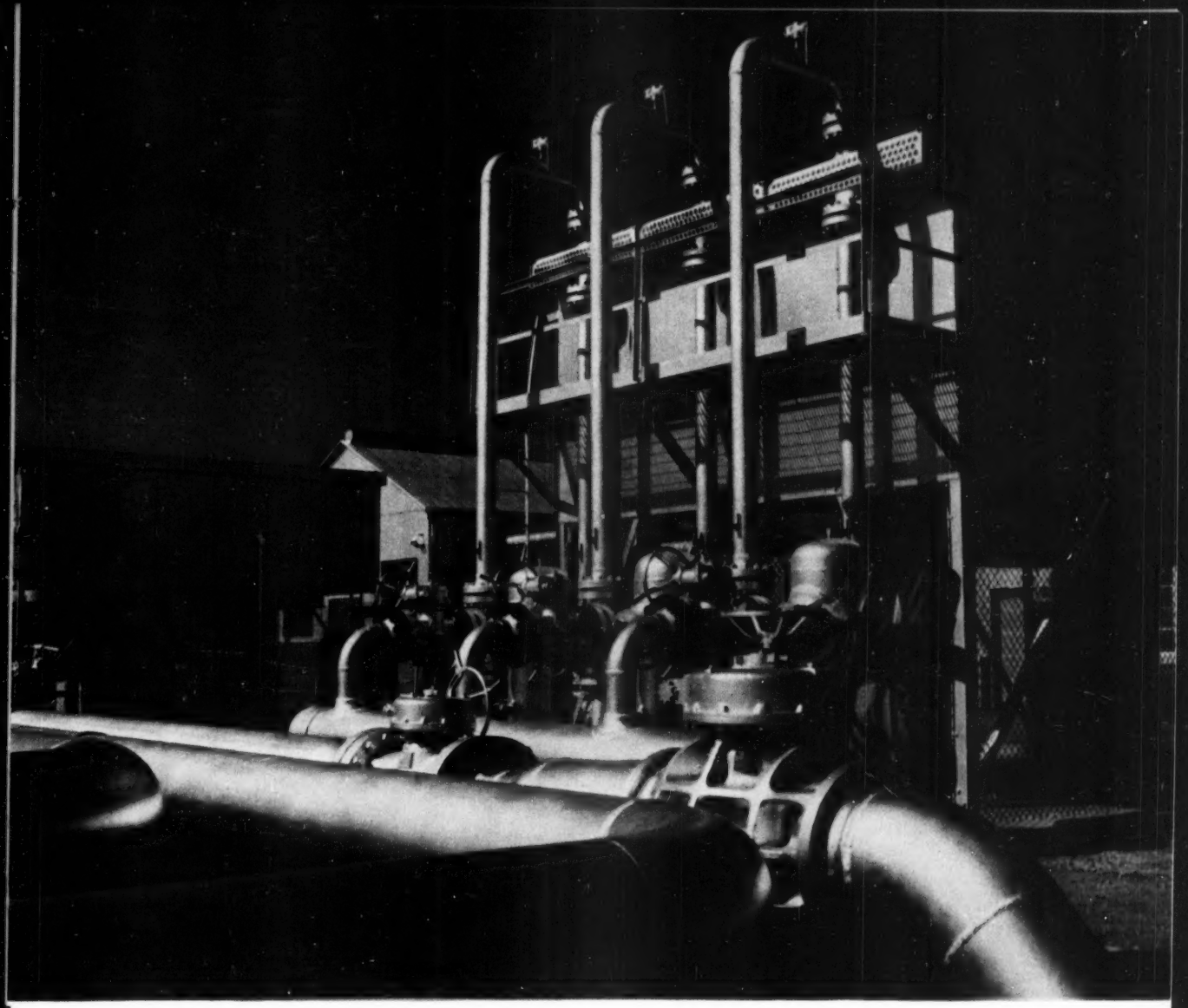
New Lines



Dean Products, Inc., Brooklyn, N. Y.—A new plate-type coil will be marketed by this manufacturer of heat exchange equipment. Thermo-Panel plate coils are simple to clean, easily installed and inexpensive. To handle the new line, Dean Products has formed a special Thermo-Panel Division.

The Carborundum Co., Niagara Falls, N. Y.—"Seneca Standard" Tripoli, an unusual silica which is double refracting and of the chalcedony variety, will now be produced by the firm as a result of the purchase of American Tripoli Corp.

Centrico, Inc., Englewood, N. J.—The Westfalia line of equipment as well as the right to use the Westfalia trademark has been acquired by Centrico from Columbia Westfalia Centrifuge Inc., Canton, Ohio. —*End*



CONSTANT CONTROL FOR CONTINUOUS PROCESSES

Ever notice how many Rockwell-Nordstrom valves you see at key points in continuous operation processes—where failure of one valve can shut down an entire plant? There's a sound reason for that: Nordstrom valves have a reputation for *not* failing.

If it's wise to use Nordstrom valves in *tough* spots—in lines that must operate 24 hours a day, 365 days a year, year in, year out—doesn't it stand to reason they'll give better service in almost *any* spot?

Nordstrom's first costs are comparable to other valves. In the long run, they're invariably the best buy. There's no substitute for Rockwell experience. Use it to save money on valves. *Rockwell Manufacturing Company, Pittsburgh 8, Pa.*

THREE WAYS
THE NORDSTROM LUBRICANT WORKS

Lubricant surrounds each valve port with a vapor tight pressurized seal. **Nordstrom valves stay tight.**

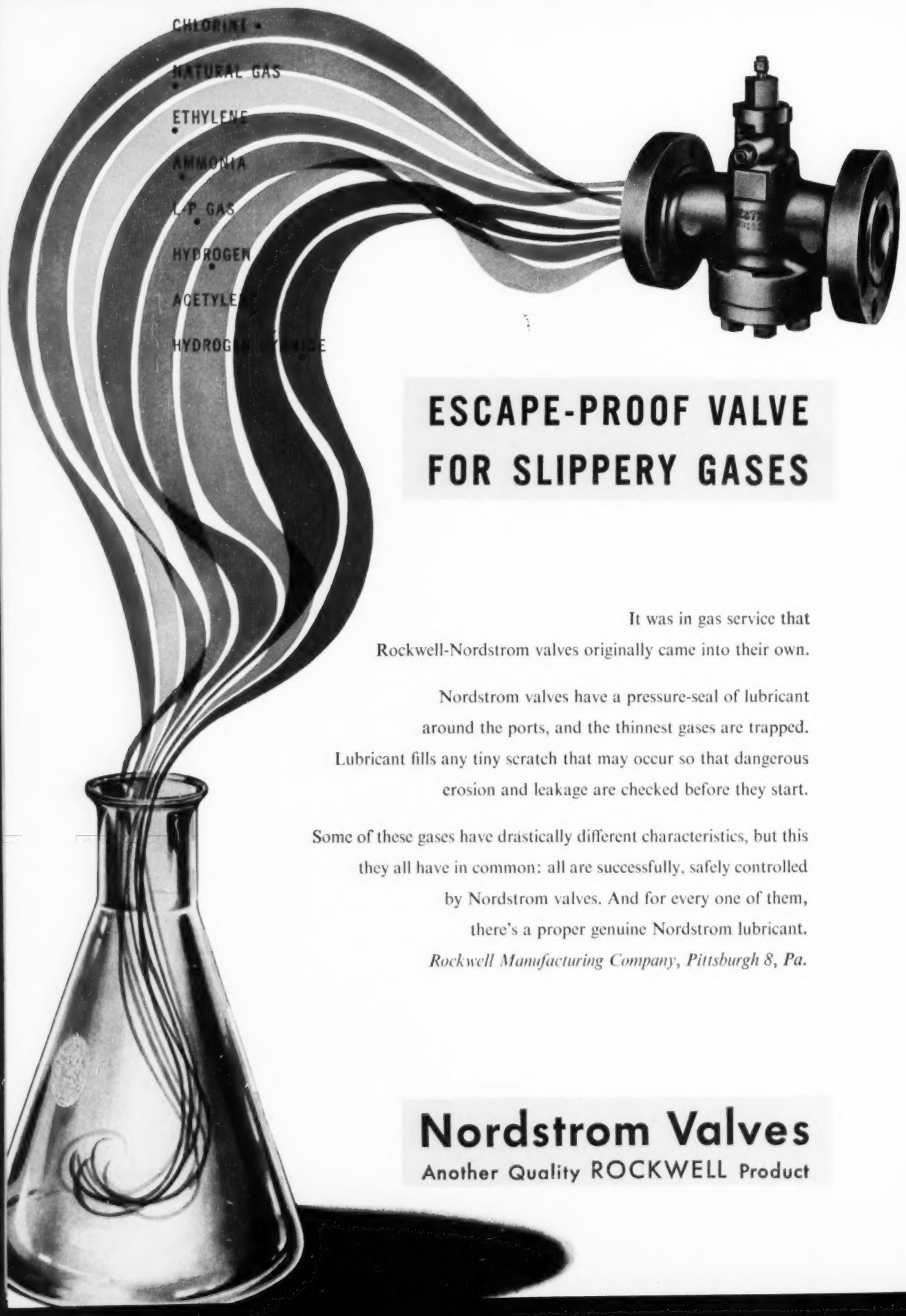
Lubricant acts as hydraulic jack—a fast quarter-turn to open or close. **Nordstrom valves operate quickly.**

Lubricant coats the plug for sliding action—no wear-producing wedging. **Nordstrom valves operate easily.**

Rockwell Built

NORDSTROM VALVES

Lubricant-Sealed for Positive Shut-Off



ESCAPE-PROOF VALVE FOR SLIPPERY GASES

It was in gas service that Rockwell-Nordstrom valves originally came into their own.

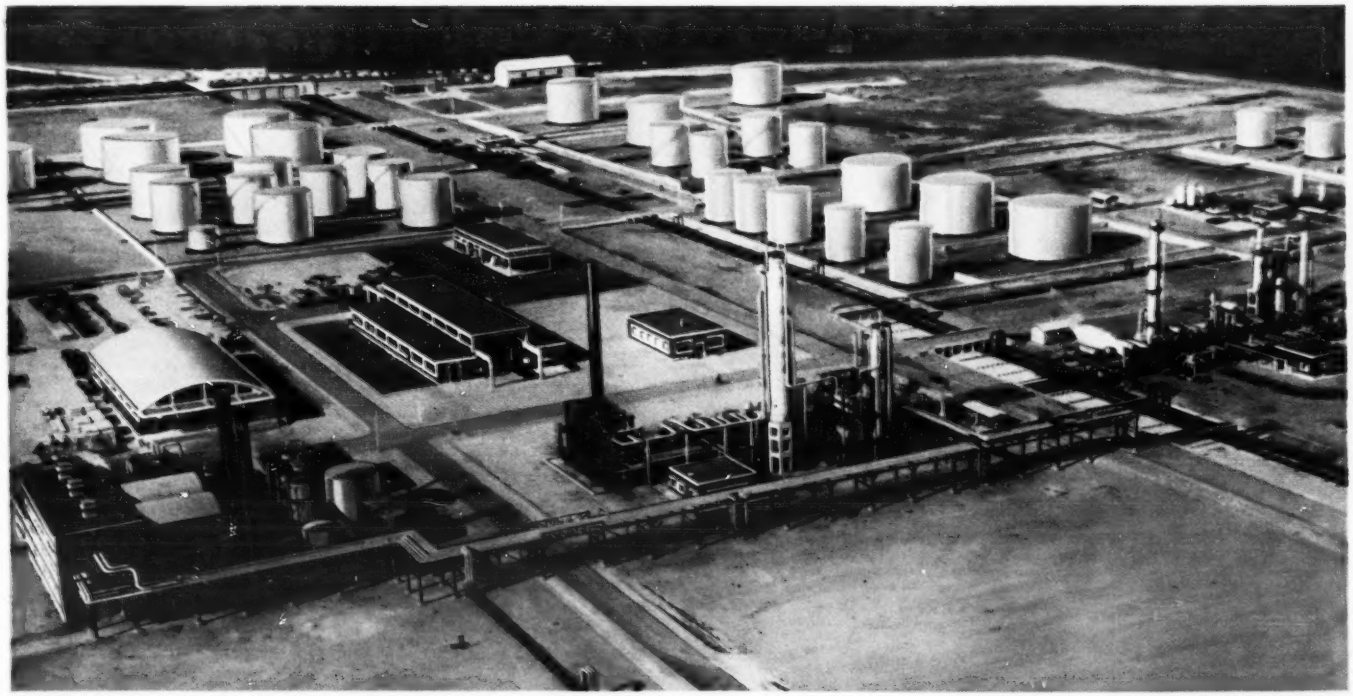
Nordstrom valves have a pressure-seal of lubricant around the ports, and the thinnest gases are trapped. Lubricant fills any tiny scratch that may occur so that dangerous erosion and leakage are checked before they start.

Some of these gases have drastically different characteristics, but this they all have in common: all are successfully, safely controlled by Nordstrom valves. And for every one of them, there's a proper genuine Nordstrom lubricant.

Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Nordstrom Valves

Another Quality ROCKWELL Product



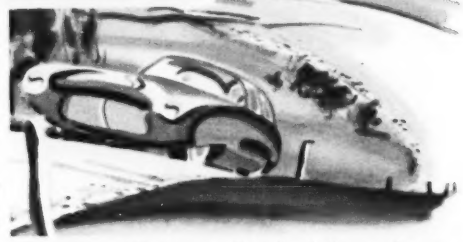
Crude oil is piped to the Sarpom Refinery at San Martino di Trecate, Italy, from Savona on the Mediterranean.

ITALY'S NEW LOOK

The basic design of the "Sarpom" refinery, recently completed on the plains of Northern Italy, is the work of Stone & Webster Engineering Corporation, with detailed engineering, procurement and construction management by its affiliate, E. B. Badger & Sons Limited.

The refinery, having a capacity of 15,000 barrels per day, consists of crude distillation, reforming, treating and general facilities. Catalytic cracking and polymerization units are now being added.

These facilities for Societa per Azioni Raffineria Padana Olii Minerali, a Caltex-Fiat subsidiary, are among eighty new refinery units recently executed by our Badger Process Division.



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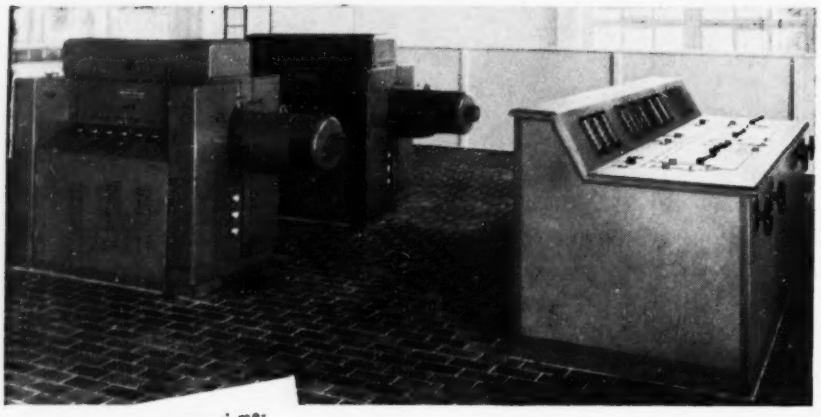

These two Brown Boveri mechanical rectifiers were installed in 1950 in an aluminum plant. They were each rated 10,000 Amps D.C. at 140-250 Volts D.C. Due to accumulated experience and design refinements, similar units are now capable of carrying 20,000 Amps D.C. . . . resulting in **appreciably lower first-cost.**

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MECHANICAL RECTIFIER

97% EFFICIENCY (at 280 Volts) **8,760 Hours a Year!**

PRACTICAL experience of over 10 years in aluminum, chlorine and other electro-chemical plants throughout the world has clearly demonstrated the outstanding qualities and overall economy of the fully compensated Brown Boveri mechanical rectifier for 60 or 50 cycles operation.

The excellent operating performance of Brown Boveri mechanical rectifiers is due to the application of the following design principles:

1—Operating with near to unity power factor, even for wide voltage range, by the use of load tap changing.

2—Relieving main contacts of any switching duty by means of a thyratron shunt circuit and auxiliary magnetization of the commutating reactors.

3—Automatic timing of the commutation period resulting in stable operation under any load conditions regardless of supply voltage fluctuations.

All of the above features result in practical immunity of these rectifiers to arc-backs from all causes, low contact wear, low maintenance and correspondingly low service costs.

Easy to install, requiring little space, Brown Boveri Mechanical Rectifiers are proving to be quickly self-liquidating investments — the direct result of substantial power savings and uninterrupted operation. It will pay *you* to get ALL the facts.

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An inspection of the contacts in the above equipment — made after 7,800 hours of continuous service — showed them to be in very good condition. They were returned to service for ***thousands of additional hours of "round-the-clock" operation.***

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The unique design of the Type SA enables it to handle light slurries, many suspensions, hot tar and similar solutions without time lag or "hunting" for the proper adjustments. Installation, inspection, cleaning and maintenance are all quickly and easily accomplished without special tools.

Kates Type SA Regulators are available with flow capacities ranging from the tiny 2-10 GPM to the larger 100-500 GPM, and may be furnished in No. 316 stainless steel trim and valves.

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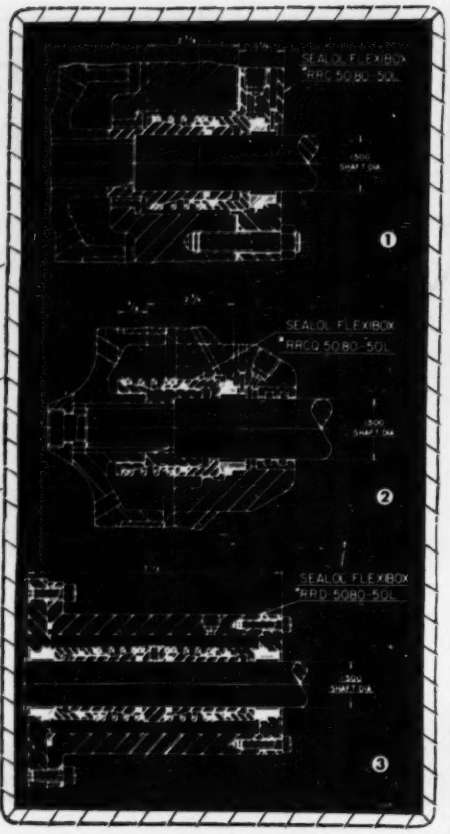

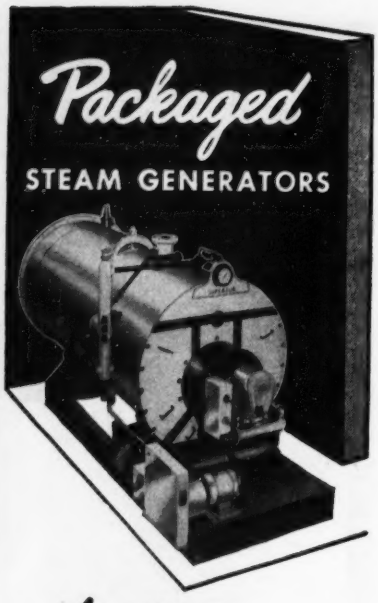

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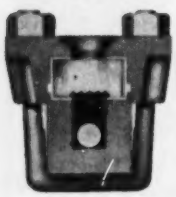

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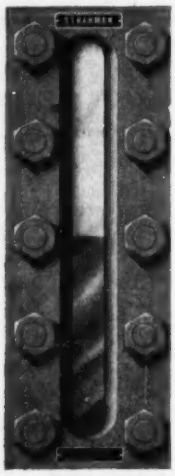

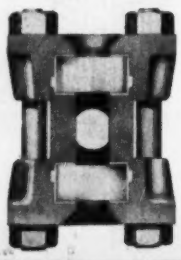

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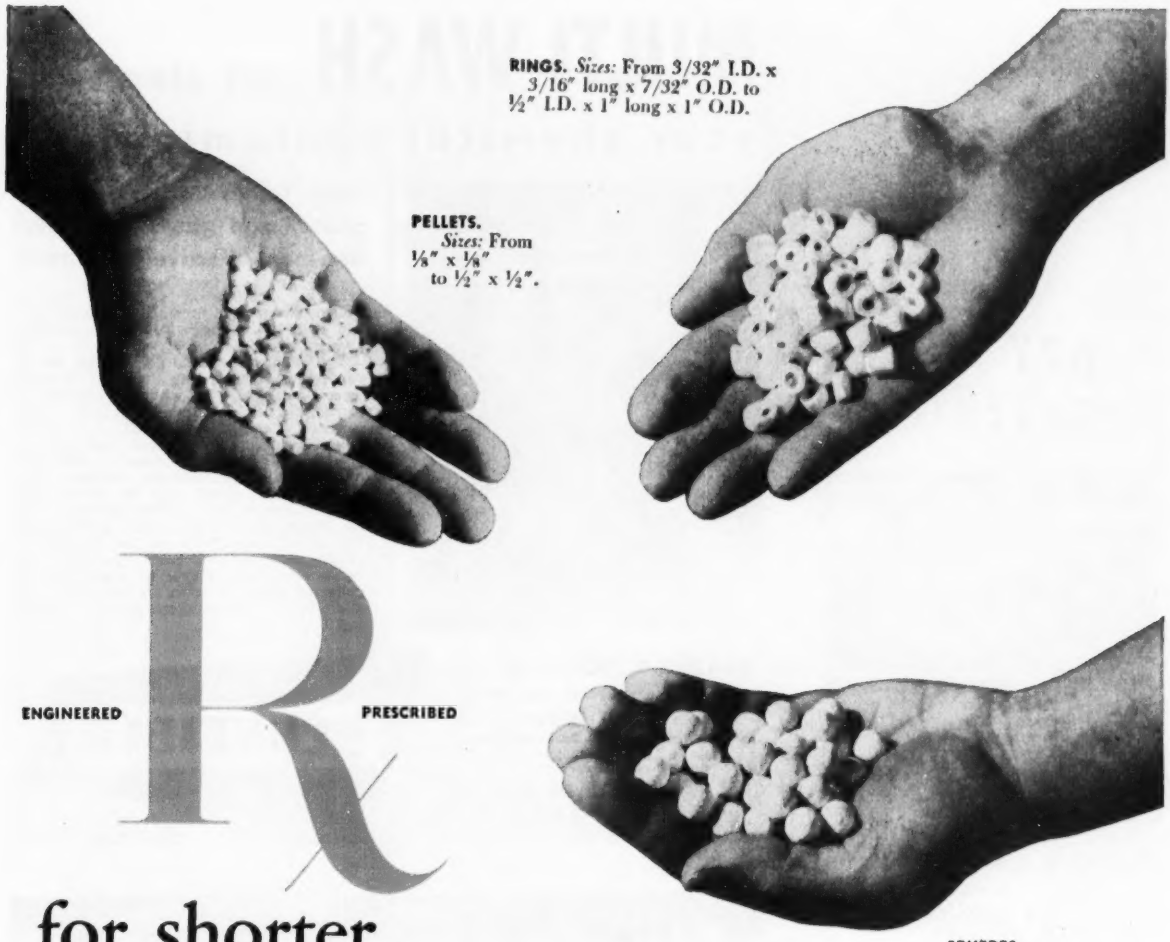
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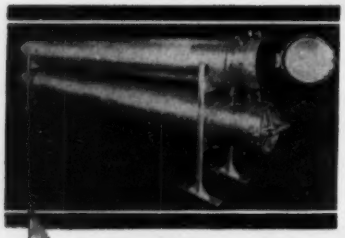

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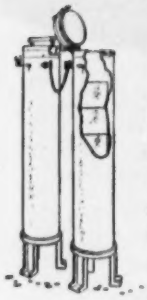

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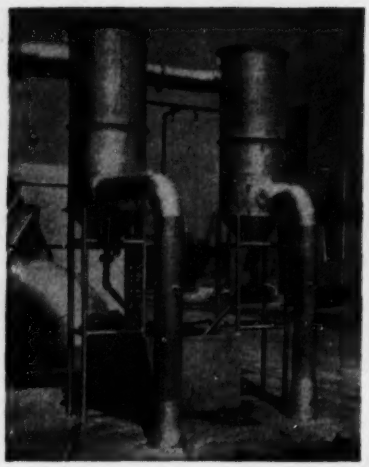

Dust, fumes, vapors, soluble gases, acid gases and odors are most effectively removed.

Schneible Multi-Wash Collectors provide efficient removal of air-borne contamination and recovery of product through multiple washing action.

The counterflow action allows air, gas or vapors to pass spirally upward through several stages at a velocity that impinges or condenses the contaminant against wetted surfaces, where they are flushed down and out the outlet cone in the liquid. The water or liquid enters the unit through a full-sized, non-clogging pipe opening so that heavy concentrations of slurry may be recirculated.

The intensive action of the air stream with the liquid curtains and spray patterns has proven very successful in the removal of soluble gases and acid gases. The liquid used varies according to type of material to be collected. Complex odors are removed by the addition of oxidizing agents in the recirculating liquid.

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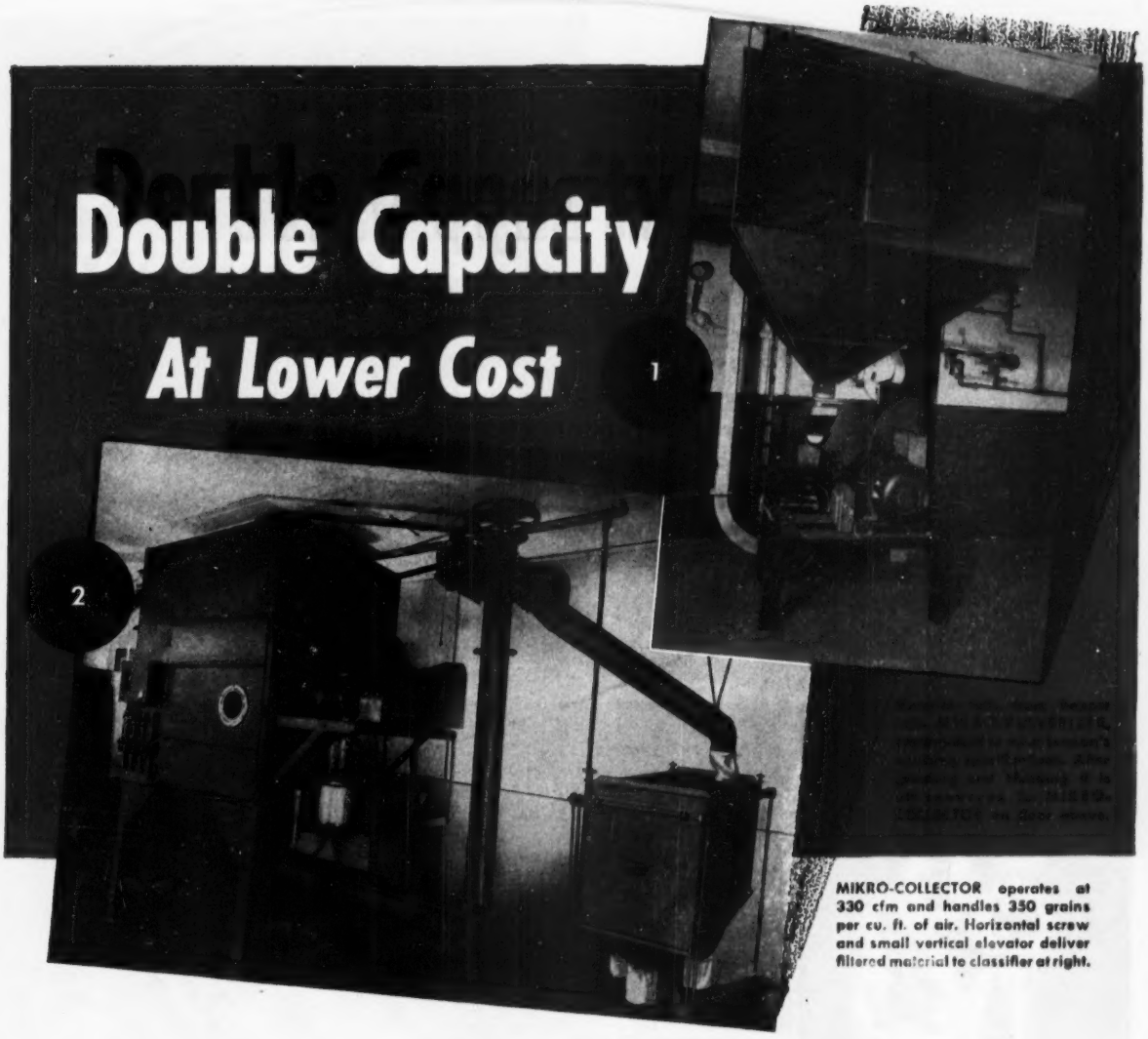


MIKRO-COLLECTOR operates at 330 cfm and handles 350 grains per cu. ft. of air. Horizontal screw and small vertical elevator deliver filtered material to classifier at right.

MIKRO'S INTEGRATED SYSTEM has again proven itself to be both a money-saver and a time-saver in the combined functions of grinding, blending and dust control.

At the SERUTAN plant in Newark, N. J., this unified method (made possible by the incorporation of the MIKRO low pressure air conveying system) has out-moded batch handling by providing a continuous, automatic flow of material from a No. 2 DH MIKRO-PULVERIZER on one floor, to a MIKRO-COLLECTOR* on the floor above.

[redacted] 100% increase in production . . . reduced cost due chiefly to elimination of batch handling . . . clean, dustless operation . . . improved working conditions . . . full product recovery . . . absolute protection of product against contamination.

This high-efficiency push-button operation steps up production by 100% for Serutan, but it can be engineered to meet almost any production quota on a wide variety of materials. It will pay you to investigate its possible application in your own plant set-up. Write now for information and descriptive literature.

*Patents Applied For by H. J. Hersey, Jr. and Pulverizing Machinery Company

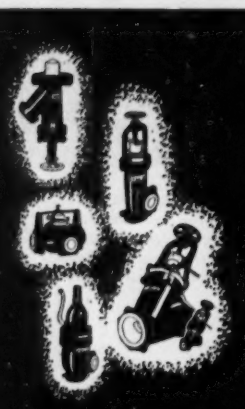
PULVERIZING MACHINERY COMPANY
55 Chatham Road • Summit, New Jersey
Subsidiary of Metals Disintegrating Co., Inc.

PRESERVE OUR HERITAGE: FAITH, FREEDOM AND INCENTIVE

MIKRO-PULVERIZER (FINE) -ATOMIZER (ULTRA FINE) -COLLECTOR (100 PER CENT)
REG. U.S. PAT. OFF.

Easy working and long life in chemical atmospheres ...for the Lapp Valve

Non-ferrous working parts in the Lapp Valve eliminate freeze-ups from scales of corrosion. Threaded stud, yoke bushing and nuts, and plug cap are all brass or bronze, which keep the valve smoothly operative in all but the most unusual conditions of chemical atmosphere. Flange, yoke and gland are of high strength malleable or ductile iron, and are protected with baked-on Epon-base acid-proof paint. Flanges are permanently bonded to porcelain or armor with acid-proof resin cement. *Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 301 Wendell Street, LeRoy, New York.*

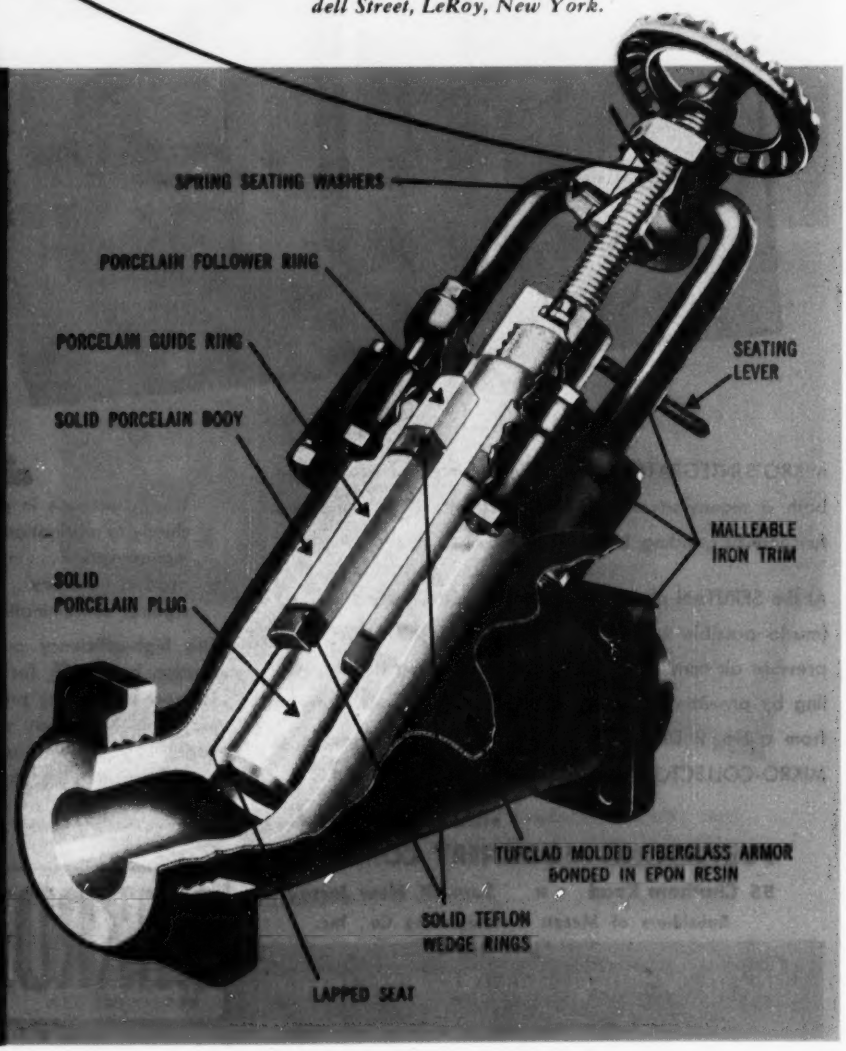


Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt circle flanges for easy connection to all piping and equipment

Lapp

PROCESS EQUIPMENT

Chemical Porcelain Valves
Pipe • Raschig Rings • Pulsafeeder
Chemical Proportioning Pumps



FASTER

MORE EFFECTIVE... MORE DEPENDABLE

FIRE-STOPPING POWER

MODEL 20-B

ANSUL
Chemical Company
FIRE EQUIPMENT DIVISION • MARINETTE, WISCONSIN

ANSUL

FIRE EXTINGUISHING EQUIPMENT

FASTER . . . A short, quick downward motion of the puncture lever pressurizes the extinguisher and it is ready for instant use.

MORE EFFECTIVE . . . Even the inexperienced operator gets near-expert results because of the ease of operation and handling. In addition ANSUL *"PLUS-FIFTY"* Dry Chemical has greater fire-killing power.

MORE DEPENDABLE . . . Exclusive ANSUL-ENGINEERED design features include water-tight and corrosion-resistant construction, easy, on-the-spot recharge without special tools and other exclusive Ansul developments which insure greater dependability.

FIRE-STOPPING POWER . . . ANSUL FIRE EXTINGUISHERS have the highest ratings for fire-stopping power ever awarded any type of class B and C fire extinguishing equipment.

Send for File No. B-202 You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

OFFICES AND DISTRIBUTORS IN PRINCIPAL CITIES IN THE U. S. A., CANADA AND OTHER COUNTRIES

MANUFACTURERS OF
DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT, REFRIGERATION PRODUCTS, INDUSTRIAL AND FINE CHEMICALS AND LIQUEFIED GASES

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AMORPHOUS PHOSPHORUS
PHOSPHORIC ANHYDRIDE
PHOSPHORIC ACID
PHOSPHOROUS ACID
HYPOPHOSPHOROUS ACID
ALKYL ACID PHOSPHATES
(Alkyl Phosphoric Acids)
SODIUM CHLORATE
POTASSIUM CHLORATE
POTASSIUM PERCHLORATE
HYPOPHOSPHITES
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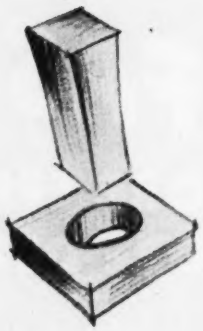
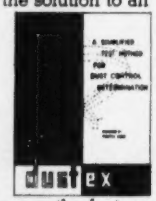


impractical!

. . . so is guessing about your dust problems!

Actually, there is no need to guess about the scope of your dust problem or collection equipment needed for effective control. The most practical way to arrive at the solution to all dust problems is to apply the simple test method described in a new booklet, "A Simplified Test Method for Dust Control Determination." This manual gives you the facts on how to get a complete analysis of dust conditions and how to be sure of effective control.



For your copy, just clip this ad to your company letterhead and sign your name and title.

dustex CORP.
1754 Walden Avenue
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for MIXING, STIRRING, AERATING, PUMPING, etc.

Manufactured by an exclusive process, MICHIGAN propellers are perfectly balanced to avoid whip and strain on shafts. And because of their superior functioning are now standard parts of the products of many leading equipment manufacturers.

MODEL GDA - MIXER BY INTERNATIONAL ENGINEERING DAYTON, OHIO

Available for special application and replacement, as well as original equipment, in a wide variety of metals and in sizes up to 60". Write for latest data folder.

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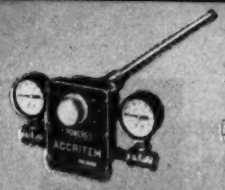
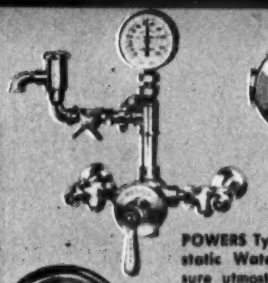
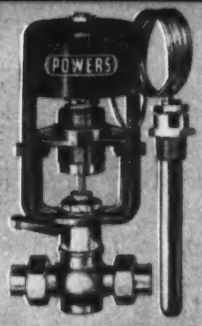


Above: POWERS ACCRITEM Temperature Regulator, is water or compressed air operated. Controls FLOWRITE diaphragm valve (right). Widely used for Water Heaters and Industrial Processes.



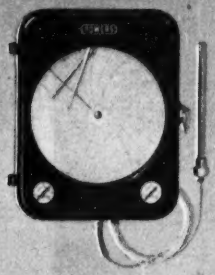
POWERS Type H Thermostatic Water Mixers insure utmost comfort and safety in showers and other types of baths.

Also used for many processes. Users report ½° F. ± accuracy. Capacities 5 to 10 gpm. @ 45 psi.

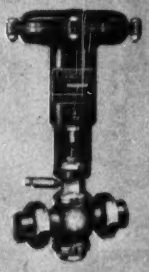


Powers No. 11 Self-Operating Regulator widely used for water storage heaters, heat exchangers, fuel oil preheaters and many industrial processes.

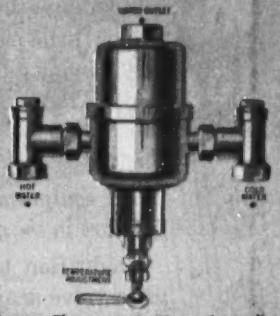
WATER Temperature CONTROL?



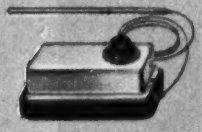
Powers Series 100 Recording Controller. Compressed Air Operated.



POWERS FLOWRITE V-Port-Characterized Diaphragm Control Valve.



Powers Thermostatic Water Controller for regulating temperature of multiple type showers, hydro-therapy and industrial processes. Capacities 22 to 125 gpm. @ 45 psi.



Powers Remote Bulb Type D Thermostat for Unit Air Conditioners.

POWERS PACKLESS VALVES

For controlling chilled, or heated water in unit air conditioners.
No leakage
No packing maintenance

Call POWERS

Most Complete Line of Controls Made Only a few are shown here

for All Types of Baths, Water Heaters and Heat Exchangers

- Forced Hot Water Heating Systems
- Radiant Panel Heating Systems
- Air Conditioning Units using Chilled and Heated Water
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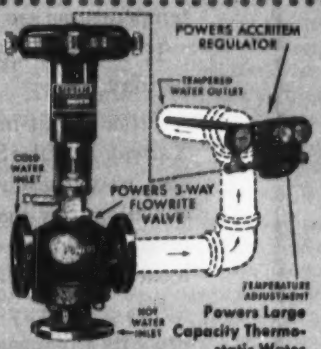
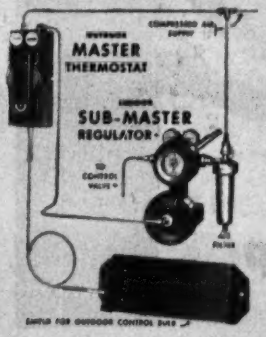
- **Many Industrial Processes:** Photo Developing, X-Ray, Color and Ordinary Film, Lens Polishing and Grinding, Chocolate Enrobers, Plastic Molding Presses, etc.

Our More than 60 Years Experience will be valuable in helping you select the right control for your requirements. Contact our nearest office or *Write us direct for Condensed Catalog Rb 24.*

THE POWERS REGULATOR CO.
Skokie, Ill. • Offices in Over 50 Cities in the U.S.A., Canada and Mexico

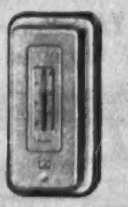


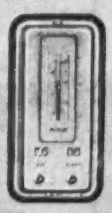
Powers Large Capacity Thermostatic Water Mixing Valve Controlled by an ACCRITEM Temperature Regulator. Capacities 20 to 1200 gpm. @ 45 psi.



Powers MASTROL Control for regulating forced hot water heating systems.

POWERS CONTROL





Powers Room Type Pneumatic Controls for Radiant Heating-Cooling Panels, Convectors and Unit Ventilators. Valves are packless. No more packing maintenance. No leakage.

(b81)

IT FLOATS ON THE LOAD! *

You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time . . .* steady, maximum temperatures are maintained.

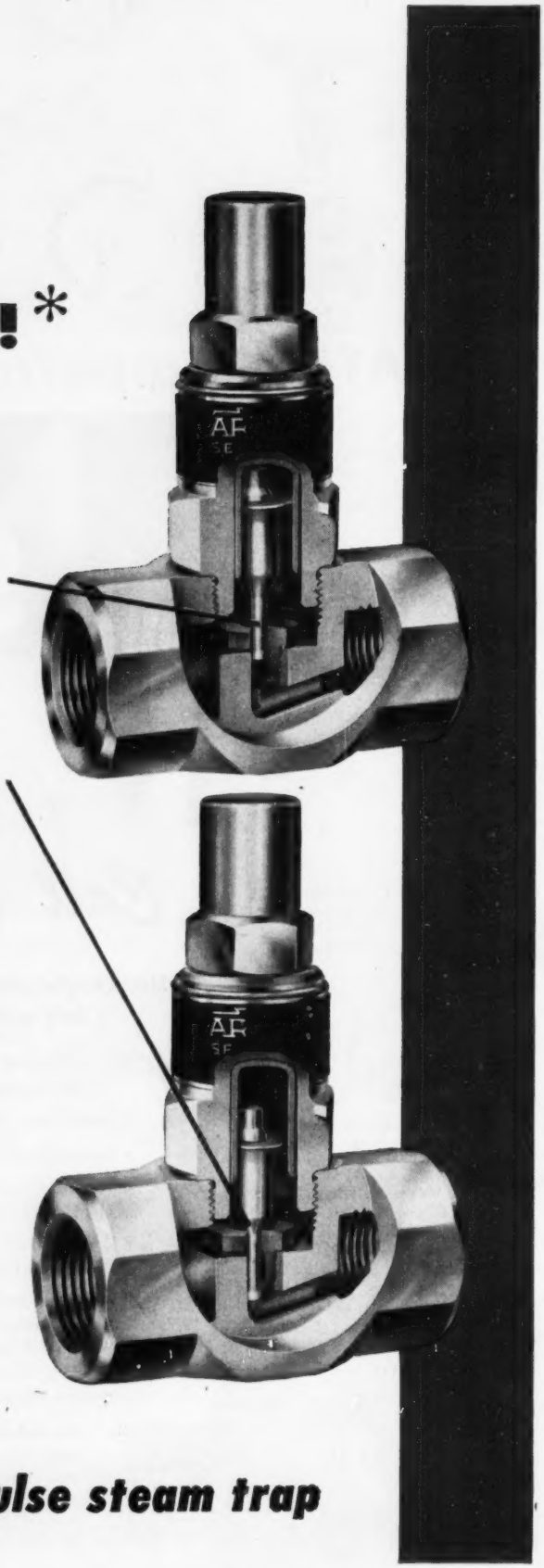
It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

Try a Yarway—free for 60 days—and *prove* its advantage. Your distributor will supply you.

For free Yarway Impulse Steam Trap Bulletin T-1740, write . . .

YARNALL-WARING COMPANY
137 Mermaid Ave., Philadelphia 18, Pa.



* . . . *resulting in fast heat-up of equipment, more production per day.*

YARWAY | ***impulse steam trap***

NOW-Make Your Own Oxygen and Nitrogen in One Generator

. . . and Save Up to 50%!

With INDEPENDENT'S newly-designed generators, you can make your own high-purity oxygen and nitrogen from the free air . . . and in the same generator.

You reduce costs up to 50% by eliminating handling costs . . . vaporizing costs . . . evaporation losses . . . residual losses . . . and transportation costs.

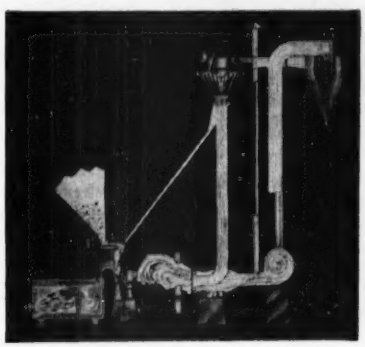
INDEPENDENT Generators are available in any capacity, any purity and any pressure. Put your oxygen-nitrogen problem up to us . . . our engineering department will gladly submit recommendations . . . no obligation, of course!

INDEPENDENT ENG. CO., Inc.

CONSULTING · RESEARCH · DESIGNING

THE MILLER CO., *Meriden, Conn.*

"WHAT'S BEHIND IT?" THAT'S *the true measure of lighting fixture value. Behind the Quality and Continuous Dependability of Miller Fluorescent, Incandescent and Mercury fixtures for industry, commerce and schools—are 110 years manufacturing know-how—1,000 combined man years field lighting engineering and million-dollar production facilities.*



IT GRINDS . . . WHILE IT DRIES . . . WHILE IT CLASSIFIES.

The Hardinge *"Thermomill"* is an ingenious combination of Conical Mill, "Gyrotor" air classification system and air preheater. It dries, grinds and classifies—in a single system—materials carrying an appreciable amount of surface moisture, reducing them to dry, finely-ground products. Write for Bulletin 17-B-11.

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COMPANY, INCORPORATED
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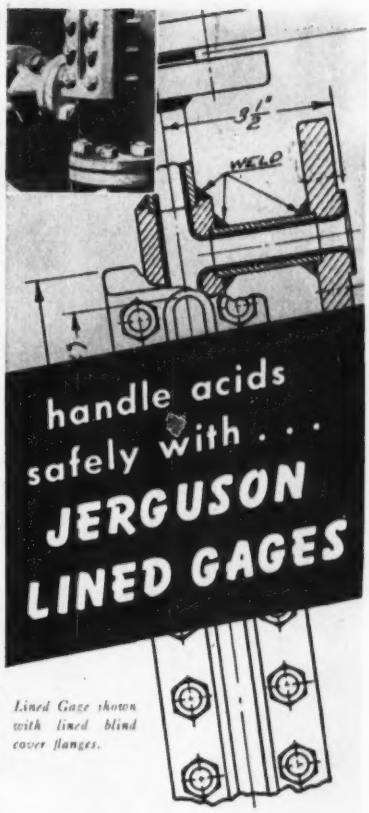
New York · Toronto · Chicago · Hibbing · Houston · Salt Lake City · San Francisco



handle acids safely with . . . JERGUSON LINED GAGES

Lined Gage shown with lined blind cover flanges.

WHERE concentration of liquids such as sulphuric, muriatic or other acids necessitates equipment with special linings, Jerguson can furnish you with reflex or transparent gages lined with natural and synthetic rubbers, lead, phenolic base compounds, Teflon, and other materials. Jerguson Lined Gages are designed to meet your requirements of long-life and dependable operation.

To meet your constantly increasing variety of demands, Jerguson engineers, working closely with the men in the Chemical and Petrochemical Fields, have developed a complete line of sound, dependable liquid level gages, valves, and specialties in various metals and synthetics to handle corrosive liquids and gases.

Jerguson Gages keep you out of trouble, and they save you time and money. Send for drawing GD-431 on Lined Gages, or send your requirements.

JERGUSON
Gages and Valves for the Observation of Liquids and Levels
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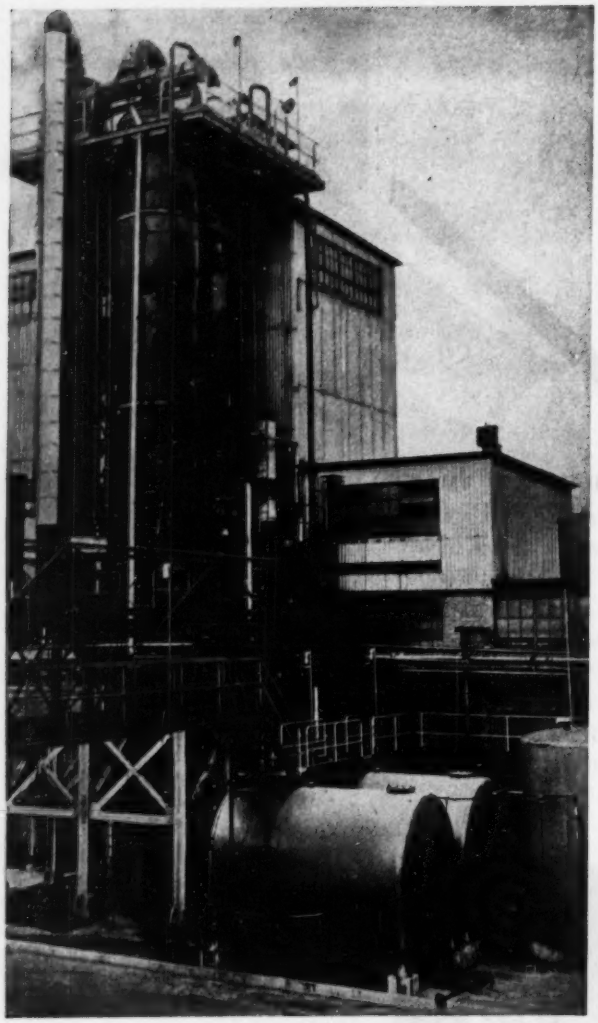
Pétrole Service, Paris, France



Phenol Purification in a Michigan plant. In this type of equipment the effect of corrosion by phenol is amplified by high temperature. To prevent trouble from this source Nickel-Clad Steel is used in fractionating columns, condensers, piping and tanks.

What does Experience Prove...

about protecting Phenol Purity and Safeguarding Equipment?

In the manufacture of synthetic phenol, corrosion is a two-edged sword.

First of all, the acids and alkalies employed in syntheses are extremely corrosive to process equipment. Secondly, even small amounts of metallic corrosion products will seriously affect the color and purity of phenol or phenolic products.

At points where corrosion is mild, it may be practical to accept minor risk . . . but at critical stages, control is essential. Experience has proven that at the majority of danger points, Inco Nickel Alloys are among the most useful common engineering materials.

During the actual manufacture of phenol, for instance, Monel is employed in sulfonators to protect against corrosion by sulfuric and benzene sulfonic acids. In processes which rely on high temperatures or pressures at critical steps, Inconel is used to furnish the necessary corrosion resistance . . . plus high strength characteristics.

In handling phenol itself, product purity is the important factor. Pure nickel equipment is therefore a standard material for storage tanks and tank cars where contact may be for long periods. Nickel is equally important in such applications as stills and fractionating equipment where metallic pickup may be accelerated by high temperatures.

If you make, ship, store, or use phenol, chances are excellent that your corrosion problems will yield to Inco Nickel or one or another of the Inco Nickel Alloys.

Inco's experience with phenol equipment problems can help you find out quickly . . . and easily.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys

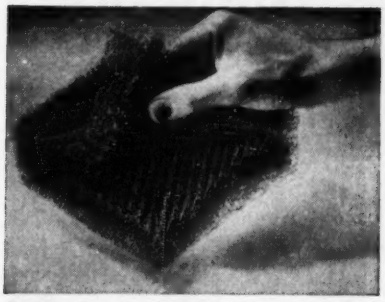
INCO TRADE MARK

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY®
NIMONIC® Alloys • NICKEL • LOW CARBON NICKEL • DURANICKEL®

Advertisement

Liquid Carry-Over Economically Controlled by Separators Made of Knitted Wire Mesh

When the removal of unwanted – and often contaminating – liquid particles entrained in a gas is considered as basically similar to the filtering of solid particles from the same type of carrier, the simplicity and effectiveness of knitted wire mesh entrainment separators is more readily understood.

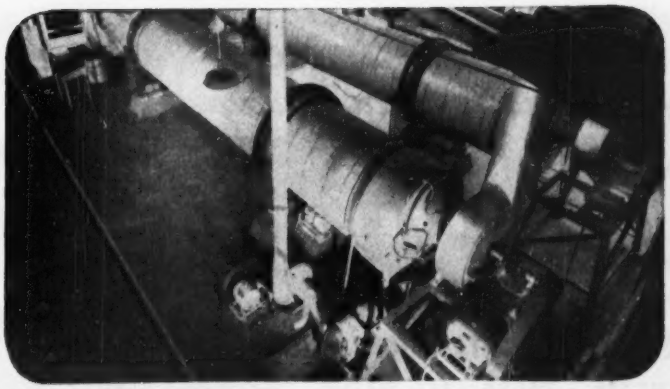


Small section of a Metex Mist Eliminator opened to show construction.

Known as Metex Mist Eliminators, these separators are built up from layers of knitted wire mesh into a unit, foraminous in structure, which removes the liquid particles by impingement and accumulation in depth. Though operating on the same principle as air filters of this type, they have one distinct advantage. The filtrant being liquid will drain from the Mist Eliminator by gravity. Entrainment removal can therefore be considered as a "continuous" rather than a "batch" operation since the "filter" does not have to be cleaned.

Metex Mist Eliminators were first used about 10 years ago to remove the liquid entrainment in a fractionator tower in one of our leading petroleum refineries. The efficiency of, and the operating economies effected by, this first installation have since been repeated in unnumbered operations which include not only petroleum refining, but petrochemical and chemical processing operations in this country and abroad.

Mist Eliminators can be easily installed in new or existing vessels. They have no moving parts to require power or servicing and need no special housings. Experience shows that they will operate over an unusually wide range of velocities with a pressure drop generally less than 1" of water. Entrainment removal efficiencies of 99% and better are commonly reported. For full information write Entrainment Separator Department, Metal Textile Corporation, Roselle, New Jersey.



"DAVENPORT" DIRECT FIRED ROTARY DRYER

If your products are not critical to high temperatures they can be dried more economically in a "DAVENPORT" Flash or Direct fired dryer. Precision controls can be furnished with dryer which will assure absolute control of temperatures.

Send for complete catalog . . . or, for quick reference, see your 1953 or '54 Chemical Engineering Catalog.

DAVENPORT

De-Watering Presses and Screens
ROTARY
Steam Tube, Hot Air and Direct Fire Dryers
Water Tube and Air Coolers

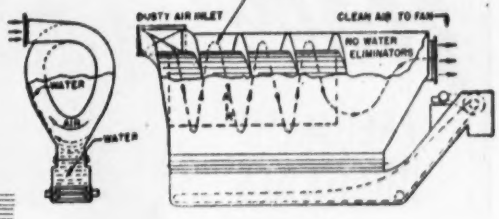
DAVENPORT MACHINE AND Foundry Company
DAVENPORT IOWA

THE MASTER OF

DUST

IN INDUSTRY

Air Tumbler



The soundness and simplicity of design, which so unmistakably distinguish the AIR TUMBLER from all other wet type dust collectors, assure not only very high efficiency of collection, but also dependable performance with a minimum of maintenance.

Recirculation of the air is accomplished without causing condensation, because of the extremely low humidification of the air by the AIR TUMBLER.

Other advantages are: no fire hazard, low water consumption, low pressure drop, and low cost.

These advantages are recognized by the users, whose re-orders contributed over 80% to our 1953 sales.

Write for Bulletin No. 531 to:

DUST SUPPRESSION & ENGINEERING COMPANY

P. O. Box 67, Lake Orion, Michigan

Agents in the principal cities. Licensees in many foreign countries.

A FULL TIME TRAFFIC COP
on your fluid hiway

HENSZEY FLOW METERS
with Alarm Control

RINGS A BELL—LIGHTS A LIGHT or ACTIVATES a MOTORIZED VALVE

There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

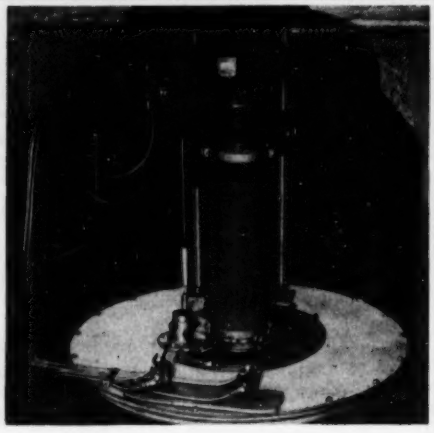
SOUND ALARM AT HIGH OR LOW FLOW!

Easy to set on face of switch — unaffected by dust, dirt or corrosion — no pitting or sticking.

HENSZEY COMPANY
DEPT. E-4 WATERTOWN, WISCONSIN

Fletcher

PNEUMATIC UNLOADER FOR CENTRIFUGALS



The latest Fletcher development in its line of modern high-speed centrifugals is the use of pneumatic controls to greatly ease and simplify unloading operation. By this means the back-breaking and fatiguing hand cranking operation is eliminated, and the operator's efficiency is materially increased. The scraper is at all times under complete control.

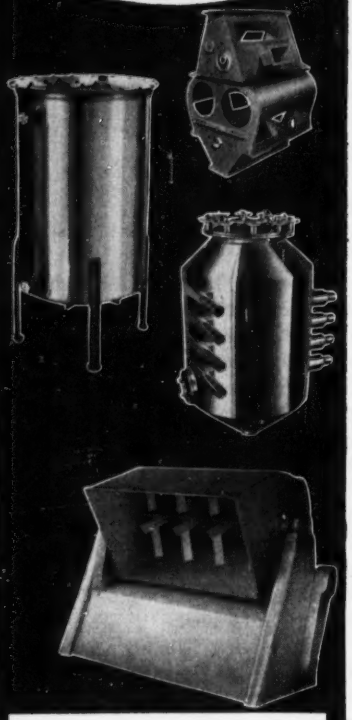
The air-operated unloader also simplifies the design of a fume hood for noxious gases.

Write today for further information.

FLETCHER WORKS
235 GLENWOOD AVE PHILADELPHIA 40, PA. ESTABLISHED • 1850

LITTLEFORD
STAINLESS STEEL
AND ALUMINUM
FABRICATED PRODUCTS
FOR THE

CHEMICAL INDUSTRY



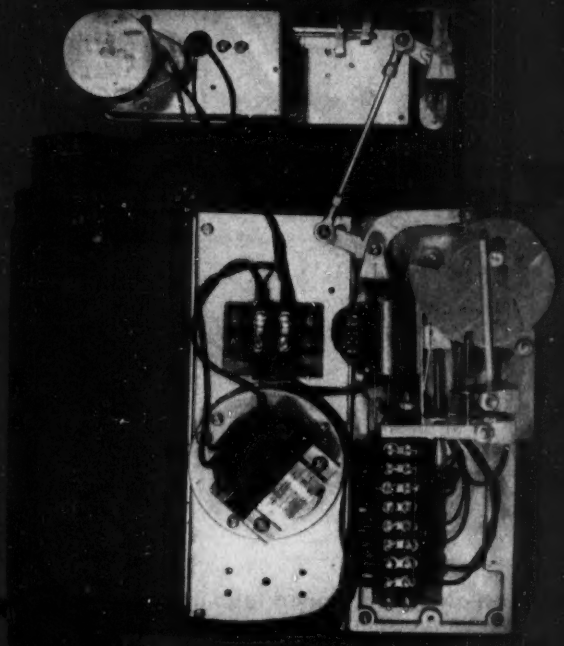
Fabricating Tanks, Bins, Vats, Troughs, Carts, or Special Units, Littleford offers its years of experience in producing quality products at low cost. Experience in shearing, bending, forming, and welding Stainless Steel, Aluminum, Nickel, Monel or other Alloy Metals plus skilled craftsmen is assurance of the finest workmanship. Littleford's modern facilities to produce non-corrosive units afford an unprecedented standard of dependability. If you need a product fabricated with accuracy, whether large or small, send blueprints to Littleford. See for yourself how it can be done the modern low-cost way.

FABRICATORS OF PLATE AND SHEET METAL PRODUCTS FOR INDUSTRY SINCE 1882

LITTLEFORD

LITTLEFORD BROS., INC.
421 E. Pearl St.
Cincinnati 2, Ohio

a new electronic flow meter!



continuous integration —no creep at zero

unaffected by normal voltage, frequency and temperature changes

electronic operation provides high speed and greater accuracy

3 to 1 range calibration at recorder

HAYS Electronic Flow Meter

Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

Indicators can be calibrated to read directly in rate-of-flow or other factors as desired.

Write today for full information on the Hays Electronic Flow Meter Bulletin 52-1074-222.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
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Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 9, INDIANA

WOLVERINE
TRUFIN* BI-METAL

WHAT IT IS! Wolverine Trufin Bi-metal is an aluminum finned tube having a liner of a different metal. *The entire fin construction is all one piece of metal.* Its fins are extruded right from the tube to greatly increase its outside surface.

THE FIRST REASON FOR SPECIFYING WOLVERINE BI-METAL: You have a choice of liner. The inside can be any corrosion-resistant alloy you may require to meet your specific condition.

THE SECOND REASON: Because the fins are integral, Trufin possesses greater heat transfer abilities in less space.

THE THIRD REASON: By virtue of this integral fin construction, Trufin has the stamina to stand up under vibration and sudden temperature changes.

THE FOURTH REASON: Because of the aluminum fin construction, Trufin bi-metal is light weight.

THE FIFTH REASON: Trufin can be fabricated, coiled or otherwise fabricated just like plain tube.

Trufin can be had also in aluminum, all copper or copper-base alloys, electric-welded steel and other metals.

All types come in a variety of fin heights and spacings. Send for our new Condenser Tube Book giving all specifications. WOLVERINE TUBE DIVISION of Calumet & Hecla, Inc. 1443 Central Ave., Detroit 9, Michigan.

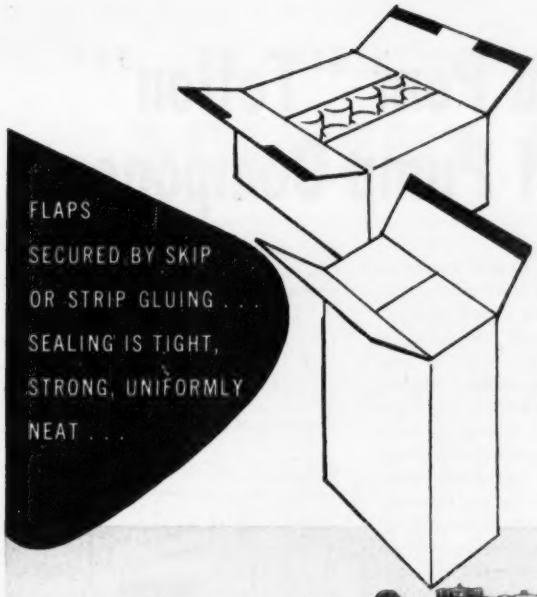
*REG. U.S. PAT. OFF. †A PATENTED PROCESS RE22465

Wolverine Trufin and the Wolverine Spun End Process† available in Canada through the Unifin Tube Co., London, Ontario.*

EST. 1916

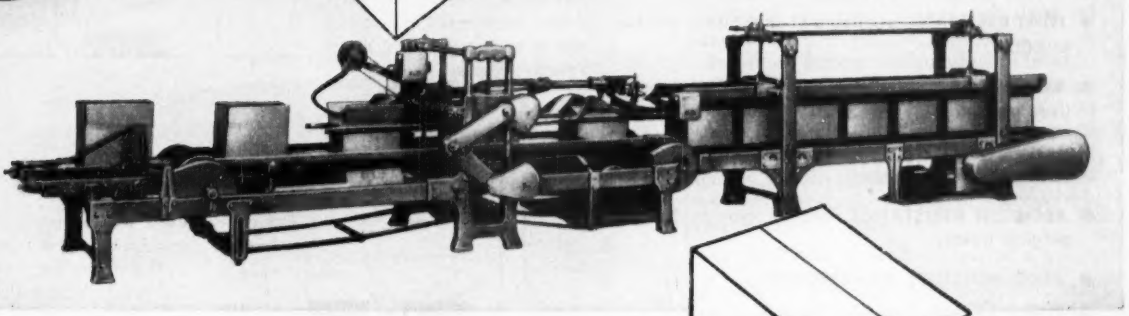
WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA • Sales Offices In Principal Cities



FLAPS SECURED BY SKIP OR STRIP GLUING . . . SEALING IS TIGHT, STRONG, UNIFORMLY NEAT . . .

PROVEN FORMULA FOR SAVINGS IN CASE SEALING . . .

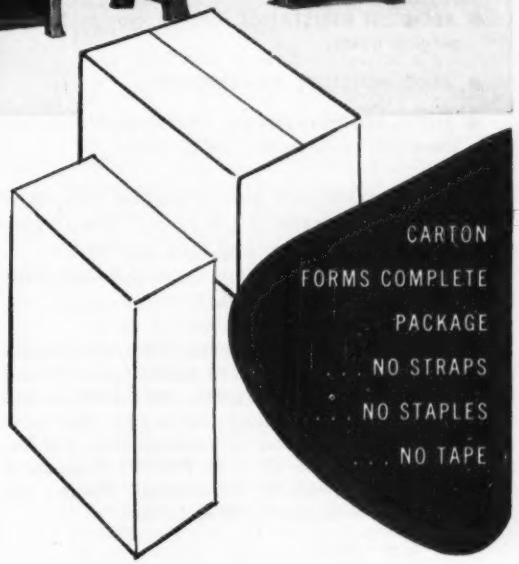


. . . automatic gluing and sealing on Standard-Knapp equipment

Standard-Knapp Gluers and Sealers are easily integrated into your operations. These machines greatly increase the number of cases that can be prepared for shipment within a given period. You can release employees for assignment to more important tasks.

Extra fastenings such as staples, strapping or tape are not required. Case sealing on Standard-Knapp equipment is strong and meets all transportation regulations. You have a wide choice of models to meet your exact requirements. High speed automatic models for volume production lines, self-adjusting types for handling varying case sizes at random and semi-automatic units for intermittent operations.

For more information about Standard-Knapp equipment, contact our nearest sales office or write Dept. V for catalogs.



CARTON FORMS COMPLETE PACKAGE . . . NO STRAPS . . . NO STAPLES . . . NO TAPE

STANDARD-KNAPP

DIVISION OF EMHART MFG. CO.

PORTLAND, CONNECTICUT

***SEE OUR EXHIBIT AT THE PACKAGING SHOW—BOOTH 346**

FULL S-K LINE FOR CHEMICAL INDUSTRY

Bottle Packers • Can Packers • Carton Packers
Carton Inserters • Gluers and Sealers
Bag Packers • Baler Sealers • Labelers

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Atlanta, Ga., Baltimore, Md., Batavia, N.Y., Boston, Mass., Camden, N.J., Chicago, Ill., Cleveland, O., Houston, Texas, Indianapolis, Ind., Los Angeles, Cal., Minneapolis, Minn., New York, N.Y., San Francisco, Cal., Seattle, Wash., St. Louis, Mo. CANADA: Fenton & Williams, Ltd., Hamilton, Ontario

How Properties of Du Pont "Teflon"* Improve Performance of Pump Components

Ever since Du Pont "Teflon" tetrafluoroethylene resin was developed, its unique combination of properties has led to an ever-increasing use as a material for pump components—gaskets, packings, impellers, bearings. Among these properties—of particular value to manufacturers *and* users of pumps—are:

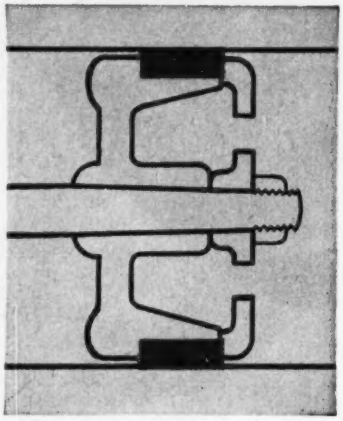
- **CHEMICAL INERTNESS.** Du Pont "Teflon" is completely inert to all chemicals and solvents, except molten alkali metals and fluorine at elevated temperatures and pressures.
- **HEAT RESISTANCE.** Capable of continuous service to 500°F.
- **LOW-TEMPERATURE TOUGHNESS.** Has been used satisfactorily to −320°F.
- **LOW COEFFICIENT OF FRICTION.** Either against itself or other materials.
- **EROSION RESISTANCE.** Resists erosion by impinging fluids.
- **ZERO MOISTURE ABSORPTION.**
- **NON-ADHESIVENESS.** The tackiest materials show little tendency to stick to "Teflon."

Illustrated opposite are some examples that show how pump components of Du Pont "Teflon" give outstanding performance and long service life . . . decrease production downtime . . . provide important savings in labor and material.

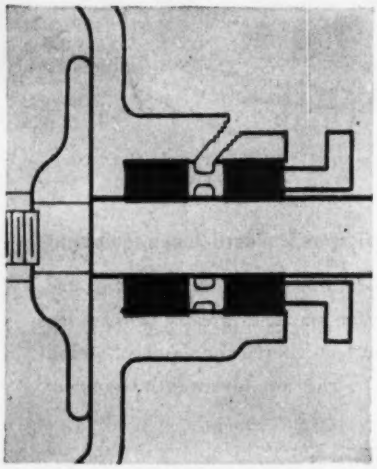
The Polychemicals Department of the Du Pont Company supplies "Teflon" in the forms of molding powders and aqueous dispersions. These forms are converted into various components for pumps, valves and other process equipment by a number of manufacturers. For further information, write: E. I. du Pont de Nemours & Co., (Inc.), Polychemicals Department, Room 254 Du Pont Bldg., Wilmington 98, Delaware.

*REG. U. S. PAT. OFF.

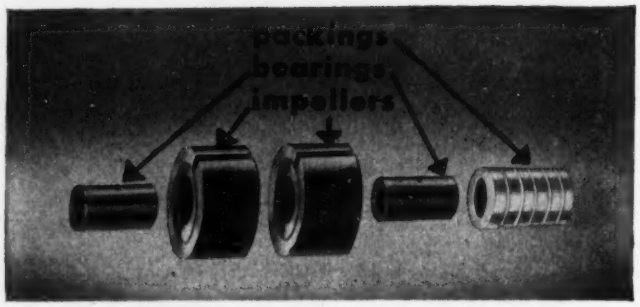
DU PONT
TEFLON®
plastic
Better Things for Better Living
. . . through Chemistry



Ability to handle corrosive chemicals under extremely severe conditions is one of the advantages of gaskets and packings of Du Pont "Teflon." This horizontal duplex pump handles a 50% concentration of NaOH at 270°F. The service life of its packings used to decrease steadily from 73 to 16 days as its cylinder became badly scored. After the cylinder was honed and packing rings of Du Pont "Teflon" were installed, these rings were still in good condition with no signs of wear on cylinder or packing after 5 months' operation.

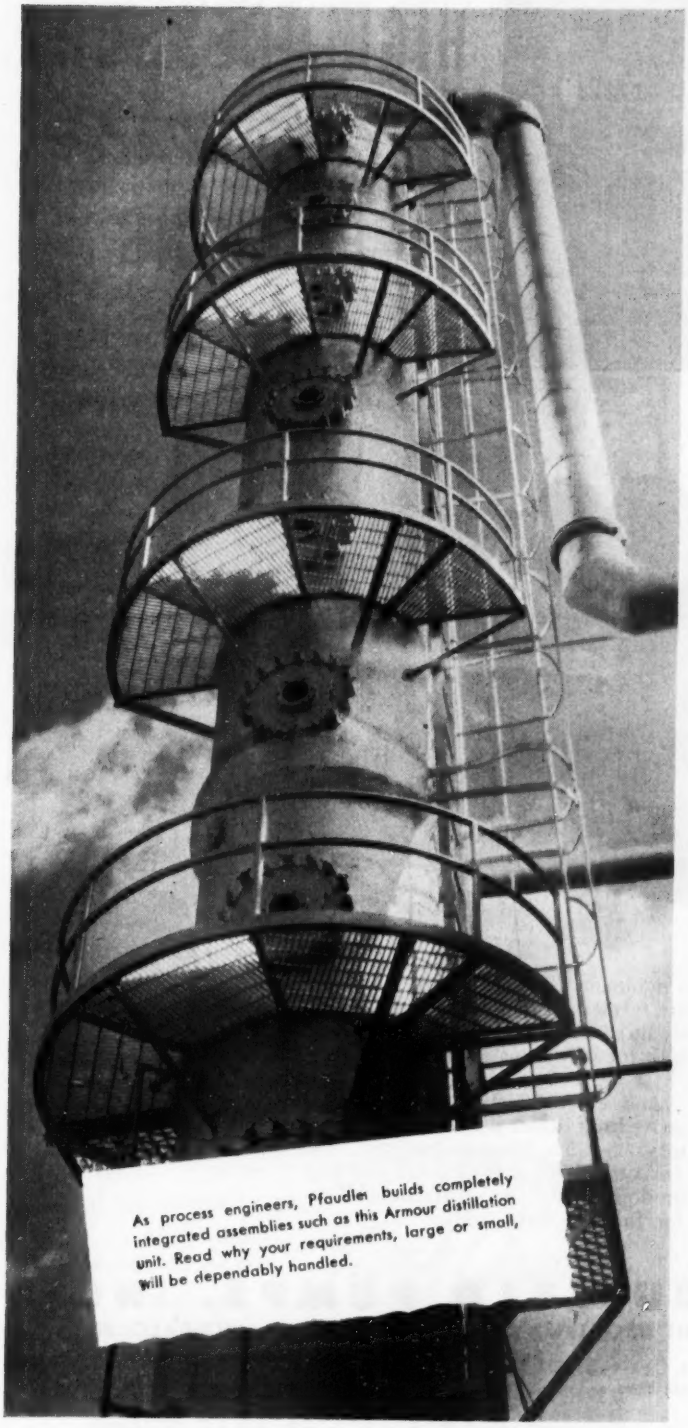


Gains in productivity often outweigh the cost of replacing packing with Du Pont "Teflon." This centrifugal pump (having a 2-in. shaft operating at 3,500 rpm) would leak badly when pumping hot "butyl extract." With a packing of "Teflon," leakage was reduced considerably. The shaft sleeve used to need replacement every few days—now it stays in good condition over several months' operation.



EXCELLENT PERFORMANCE is assured with impellers and bearings of Du Pont "Teflon." When a positive-displacement pump is equipped with impellers, bearings and packings of "Teflon," the pump can usually handle a much wider range of chemicals. These impellers are strong enough to withstand high tangential loads. They won't gall, shrink, swell, crack or harden. The bearings need no lubrication and won't become pitted even when operated in acids. The packings, too, give long, trouble-free service.

SOLVENT RECOVERY...



As process engineers, Pfaudler builds completely integrated assemblies such as this Armour distillation unit. Read why your requirements, large or small, will be dependably handled.

how Armour got performance as ordered

You know how important it is to have a process measure up to expectations . . . and how difficult this is to achieve. When the Armour Laboratories needed a solvent recovery unit for its new Pharmaceutical Center, Pfaudler submitted quotation on a "complete package." Included in this "complete package" were the best of pharmaceutical engineering ideas.

Intended for recovering alcohol used in making insulin, liver extracts, gamma globulin and similar biologicals, it was essential to have equipment that would prevent contamination of the recovered alcohol. Knowing this and input-and-output requirements, Pfaudler process engineers went to work.

A package in 316 stainless steel

As a result, Pfaudler designed, built and installed the "package" distinguished by the 53-ft. distillation tower shown. Heat exchangers, pumps, valves, piping and other components make up the assembly. It was all built of type 316 stainless steel to avoid rusting and metal pickup from the salts present in organic material. What's most important, the unit is performing for Armour as ordered.

Here is just one more example of how you can depend on Pfaudler experience and skill to deliver "complete package units" that give you the results you want.

No limit on fabrication requirements

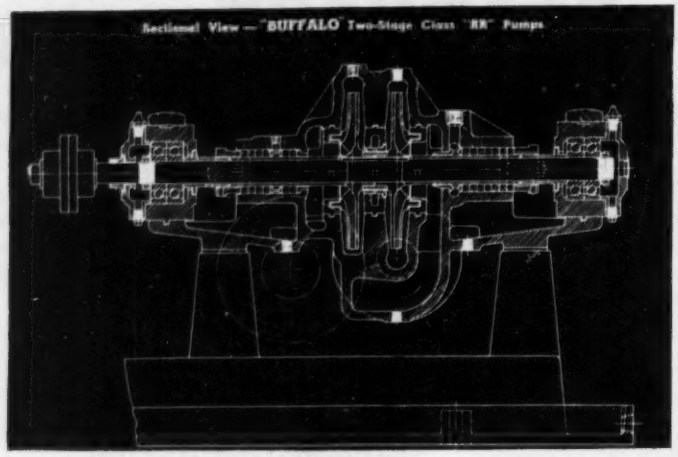
Try us out on *your* requirements—whether it involves a complete process assembly or individual units. Our facilities permit us to fabricate everything from glassed steel to alloys and clad materials. Our heat-treating furnaces are among the largest in use. Send for Bulletin 902-AA-4 . . . it explains how you can use Pfaudler process engineering to advantage.

THE PFAUDLER CO.

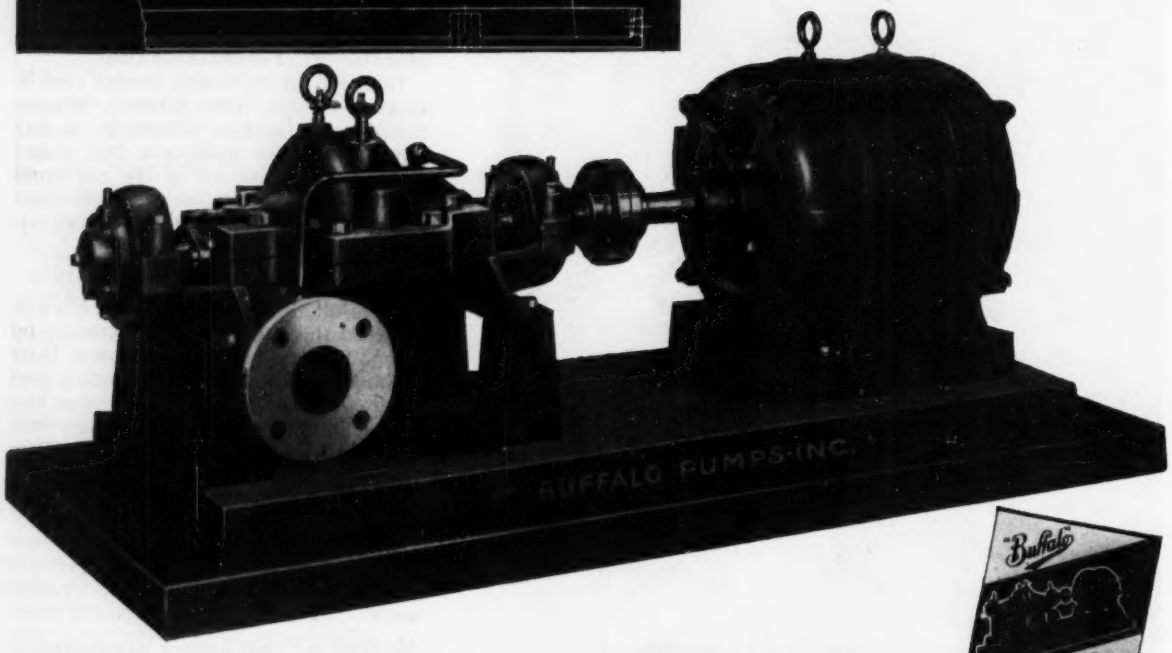
ROCHESTER 3, N. Y.

GLASSED STEEL • HASTELLOY • ALUMINUM • CARBON STEEL • SOLID OR CLAD STAINLESS STEEL • NICKEL • INCONEL • MONEL

BLUEPRINT FOR SATISFACTION



in HIGH-PRESSURE *Clear Water* PUMPING



A look at a sectional drawing of a "Buffalo" 2- or 4- stage Type "RR" Pump will readily show you why this pump is giving complete satisfaction. Full ball bearing support on each end of the oversize shaft gives the pump strength where it counts. The husky, enclosed impellers mean lastingly high efficiency. The deep stuffing boxes (large enough for 7 rings of packing in the 2-stage model illustrated) keep maintenance to a minimum. Passageways in the casing are formed to give a "path of least resistance," and the casing is horizontally split for easy rotor inspection.

And every "Buffalo" Pump *has* to prove itself before it ever leaves the factory . . . in a thorough load test. You *know* it will do your job . . . and keep on doing it . . . to satisfaction. Write for Bulletin 980-C today!

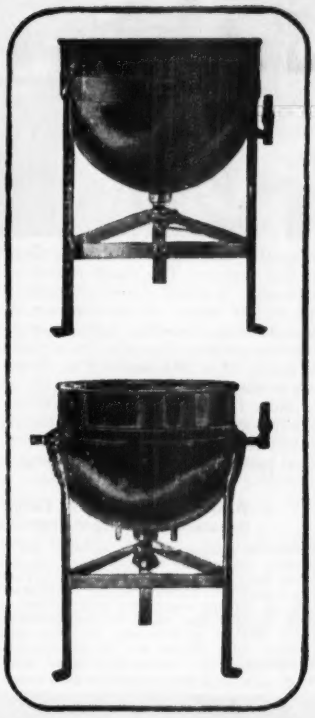
Write for Bulletin 980-C Today!

"Buffalo" PUMPS

BUFFALO PUMPS, INC.
501 BROADWAY BUFFALO, N.Y.
Subsidiary of Buffalo Forge Company
Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

LEE
CORROSION-RESISTANT KETTLES



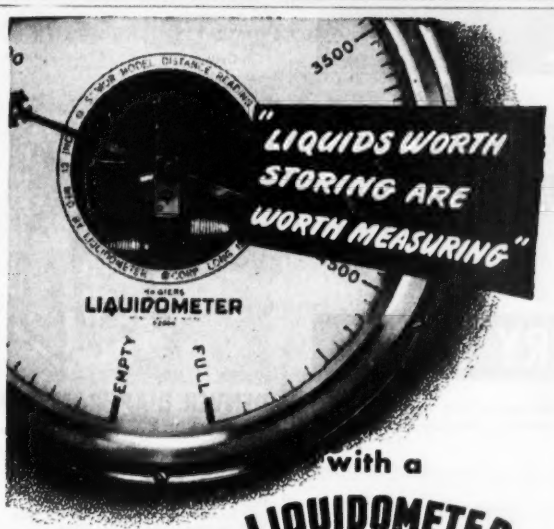
Lee Kettles meet every processing need. They are practical, easy to clean and keep clean, meet all sanitary regulations and are available in sizes up to 500 gallon capacity.

For longer service and greater all-around dependability, specify LEE *Corrosion-Resistant Kettles.*

Our descriptive technical bulletins sent on request.

LEE METAL PRODUCTS CO., INC.
417 PINE STREET, PHILIPSBURG, PA.

ALL LEE KETTLES ARE MADE TO A.S.M.E. CODE



with a **LIQUIDOMETER** *Tank Gauge*

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

WRITE FOR COMPLETE DETAILS

THE LIQUIDOMETER CORP.
629 SKILLMAN AVE. LONG ISLAND CITY, N.Y.

SCRUBBING CORROSIVE GASES?

Fig. 645

Are your scrubbing nozzles as efficient as you think they could be? Do they resist the corrosion or wear conditions satisfactorily — produce the breakup and distribution you would like?

Outline your spray problem for us—if your liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzles.

NOZZLES FOR:

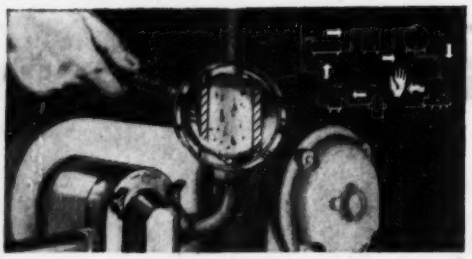
- OIL ATOMIZING
- HUMIDIFYING
- AIR WASHING
- DESUPERHEATING
- SPRAY PONDS
- MILK POWDERING
- ACID CHAMBERS
- CONCRETE CURING

Write for Catalogs 6-A and 6-C

MONARCH MFG. WKS., INC.
2517 E. ONTARIO ST.
PHILADELPHIA 34, PA.

WHEN PUMPS WEAR OUT...WHO IS AT FAULT?

STOP RECIRCULATING CLEANING SOLUTIONS

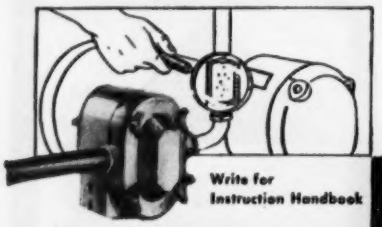


Your cleaning solutions become *"grinding"* solutions if you *recirculate* them through close-tolerance pumps like the Waukesha! Cleaning solutions in themselves, if they contain no strong organic mineral base acids cannot damage Waukesha Stainless Steel Pumps, (unless left in contact with pump parts long enough to etch the metal). But after running these solutions through your lines you pick up minute abrasive substances, grit, milkstone and dirt that can be both costly and dangerous if forced back through the close tolerances of the pump. These "in-the-line" abrasives score metal surfaces, eventually wearing down the impellers and interior surfaces. The result is loss of displacement, lowered delivered capacity — and earlier repair or replacement. So, if your cleaning procedure calls for pumping cleaning solution through production lines by means of a Waukesha P.D. Pump, be sure to discharge the solution at the end of the line. *Don't Recirculate It!* What you save on caustics you'll lose many times over in pump repair or loss of efficiency, because just a little dirt turns cleaning into a *"grinding"* operation that shortens pump life.

Waukesha P. D. Sanitary Pumps
... Investment in Product Protection

Protection against aeration, agitation of your product depends on *retaining* the close tolerances built into every Waukesha P.D. Pump. It's a precision instrument that deserves the best of inplant care, and will reward you with months and years of longer service, more efficient performance at lower maintenance cost. Write for latest instruction handbook — and catalog showing all models.

*P.D. — Positive Displacement — Slow Speed



Write for Instruction Handbook

WAUKESHA FOUNDRY CO.
1342 LINCOLN AVENUE • WAUKESHA, WIS.

Waukesha 100% SANITARY PUMPS
Dependable Product of a Responsible Manufacturer

TO CUT COSTS....

DON'T HAUL LIQUIDS....

PUMP THEM FAST

with a VIKING ROTARY PUMP

Whether your liquids are so thick they don't want to flow, or so thin they have to be kept in a closed system to keep from gasifying there's a Viking built in the size and type to fit YOUR needs.

½ to 1050 gallons per minute capacity range.

Over 600 cataloged models.

Thousands of special designs.

50 pounds maximum pressure per square inch on standard models.

250 pounds maximum pressure per square inch on heavy-duty models.

500 pounds maximum pressure per square inch on hydraulic oils.

All types of drive arrangement.

VIKING AN HONORED NAME IN PUMPING

Get complete facts from your nearest Viking distributor or send for bulletin 54SC today.

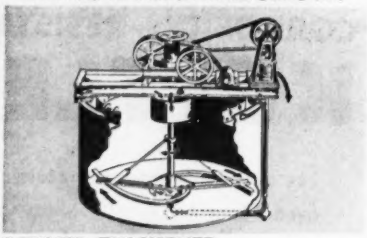
See Our Catalog in SWEETS

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

DENVER EQUIPMENT

DENVER EQUIPMENT COMPANY 24 HOUR SERVICE

...NOTE THESE FEATURES...

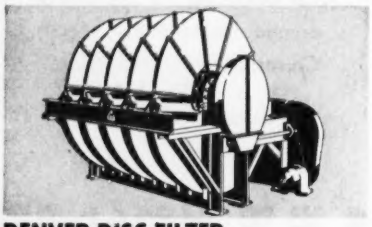


DENVER THICKENER

Size: 6' diameter to 60' diameter.

Features: Beam superstructure, spiral rakes, cut gears in integral lift reducer.

Price examples, with steel tank less drive. FOB Denver.	8' dia. x 6'	$1427.00
	20' dia. x 10'	3476.00
	30' dia. x 10'	6959.00

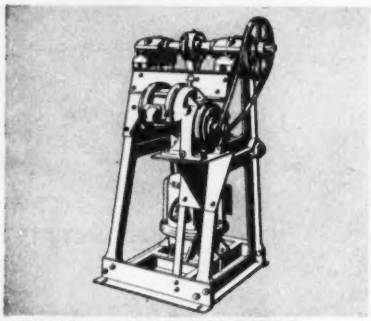


DENVER DISC FILTER

Size: 2', 4' and 6' dia. 2 to 8 disc.

Features: Oversize center shaft, simple renewable automatic valve.

Price examples, less drive and vacuum equipment. FOB Denver.	2' dia. x 2 disc.	$1573.00
	4' dia. x 3 disc	2272.00
	6' dia. x 4 disc.	4202.00



DENVER DIAPHRAM PUMP

Size: 1" Simplex to 6" Quadruplex.

Features: Adjustable stroke, molded rubber valve seats, positive action.

Price examples, less motor. FOB Denver.	2" Simplex	$ 406.00
	4" Duplex	824.00
	6" Duplex	1914.00

DECO FLOAT ENGINE 24 HOUR SERVICE

DENVER EQUIPMENT COMPANY

"The firm that makes its friends happier, healthier and wealthier"

EL PASO, MEXICO, D. F., VANCOUVER
LONDON, JOHHANESBURG

Technical Bulletins on Request

DORR Developments in the field of concentrated fertilizers:

THE DORRCO STRONG PHOSPHORIC ACID PROCESS... the first process successfully developed for producing a strong acid. In operation, it has conclusively proven that it will economically and reliably produce 32 to 33% P_2O_5 phosphoric acid with a single stage of filtration.

THE DORRCO FINES RECIRCULATION SYSTEM... produces a 100% granular product of exceptional uniformity. This is the only system which can be used interchangeably to produce triple superphosphate, ammonium phosphates, ammonium sulfate or complete granular concentrated products.

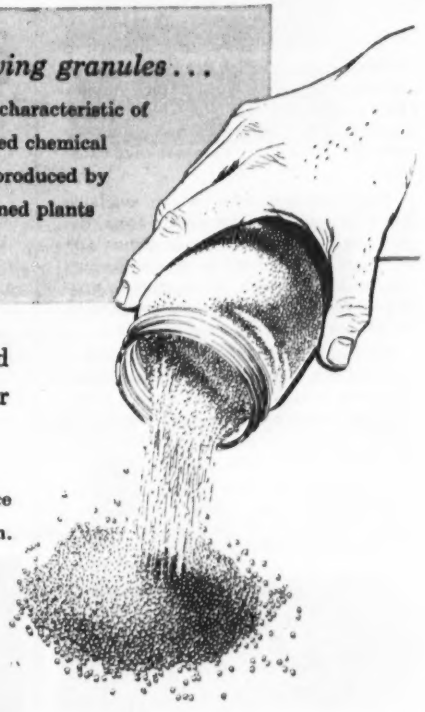
A CONTINUOUS METHOD of producing granular triple superphosphate with evaporation to only 38 to 39% P_2O_5, with no need for subsequent aging or curing of the product.

THE DORRCO SYSTEM of continuous vacuum evaporation which eliminates serious scaling, reduces P_2O_5 losses to a negligible point and involves no fume problem.

THE MANUFACTURE of ammonium sulfate from calcium sulfate obtained as a by-product of phosphoric acid production.

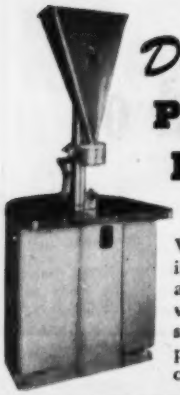
THE DORRCO FLUOSOLIDS SYSTEM... a new method for producing high strength SO_2 gas from pyrite and for the calcination of phosphate rock.

free-flowing granules...
important characteristic of concentrated chemical fertilizers produced by Dorr-designed plants



Dorr operates a complete consulting engineering service backed by 35 years of experience in the field of concentrated fertilizer production by the wet process.

Bulletin No. 8000 gives additional information about Dorr's experience and facilities in this field. Write to THE DORR COMPANY, Stamford, Conn.



Dustless POWDER FILLING

Vacuflow powder filling equipment operates on a principle of vacuum feeding, instead of pressure, to pack powder into a container.

VACUFLOW

Air is removed from the container to create a vacuum which draws a measured quantity of powder from the hopper. There is no problem with dust control, since the unique Vacuflow method simply does not involve air currents that cause dust.

Semi-automatic models are available for filling containers ranging from the tiny talcum box up to and including 100 lb. paper bags and 200 lb. drums. Rotary models are available for automatic production of 5 lb. sizes or less at speeds of 45 to 300 per minute.

Pneumatic is the one manufacturer in a position to furnish machines for making up complete production lines. Units are available for air cleaning, powder and liquid filling, capping and labeling a wide range of bottles, cans or jars.

PNEUMATIC SCALE CORP., LTD.
85 Newport Ave., Quincy 71, Mass.
Also: New York; Chicago; San Francisco; Los Angeles; Seattle; Leeds, England

PNEUMATIC

New Type Eppenbach COLLOID MILL

Featuring

Large Tangential Outlet which prevents back pressure and allows increased output capacity
Both Rotor & Stator are Interchangeable Stellite rings and stones—facilitating replacement when required.

Sanitary fittings throughout.
Illustration shows large production Mill Model QV-11 with 15 H.P. motor

***Eppenbach* Colloid Mills operate at speeds approaching the theoretical minimum required for true wet micro grinding—shaft speeds up to 10,000 r.p.m. depending on size and type of mill.**

These Mills assure uniform grind through advanced engineering features including (1) Improved ball bearings which center the shaft and minimize lateral whip and (2) Invar shafting with zero coefficient of heat expansion.

All Mills can be made with pressure feeds and jacketed hoppers.

Consult our Sales Department with your technical problems.

Write for literature describing *Eppenbach* equipment —now manufactured and sold by:

Direct-drive model shown operates at 3500 RPM.
Higher speeds can be furnished.
Colloid Mills made in all sizes from ½ H.P. model laboratory size to 50 H.P model.

ADMIRAL TOOL & DIE CO., INC.

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Equip your valves for POWER OPERATION

Standard Plug Valve equipped with Tandem Type Actuator.

with *Ledeen* Valve Actuators

These actuators are for power operation of gate, plug diaphragm, and other line valves. They are pneumatically or hydraulically operated for direct or remote control. Designed as package units, they are mounted directly on the valves without need of special manifolds or outside supports. Easily, quickly and rigidly installed on new valves or on valves in service . . . *Prompt delivery.*

WRITE FOR BULLETIN 3000

High Pressure Gate Valve with Hydraulic Actuator.

Diaphragm valve with Air Actuator.

Ledeen Mfg. Co.

1602 SOUTH SAN PEDRO
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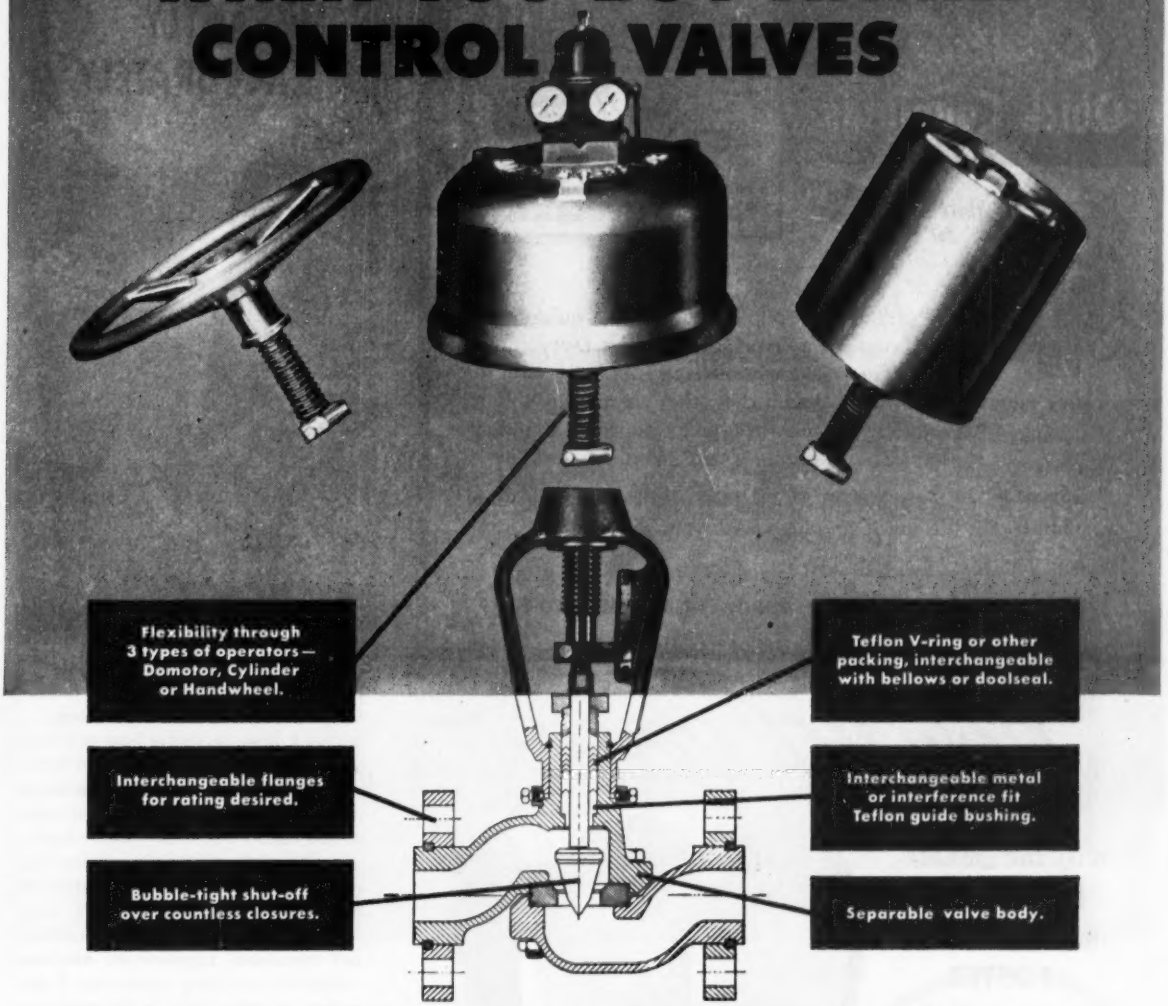
VALVES • CYLINDERS
VALVE ACTUATORS
AIR HYDRAULIC
PUMPS & BOOSTERS

HERE'S WHY YOU GET MORE WHEN YOU BUY ANNIN CONTROL VALVES


Flexibility through 3 types of operators—Domotor, Cylinder or Handwheel.
Teflon V-ring or other packing, interchangeable with bellows or doolseal.
Interchangeable flanges for rating desired.
Interchangeable metal or interference fit Teflon guide bushing.
Bubble-tight shut-off over countless closures.
Separable valve body.

The design and construction features shown in the above composite Annin valve were pioneered and developed by The Annin Company. They graphically *show why* you benefit by the established leadership of Annin control valves, whether your process is that of a chemical plant, petroleum refinery, electric or gas utility, paper mill or that of any industry requiring precise control of difficult fluids ordinary valves cannot handle. Annin valves are flexible in operation—Domotor, manual or cylinder. They have no equal in the handling of all types of fluids—corrosive chemicals, steam or gas, flashing condensates or petroleum fractions, chemical slurry or paper pulp, at high or low temperature or pressure. You will profit by investigating the advantages of Annin control valves today!

ONLY ANNIN MAKES A COMPLETE LINE OF SINGLE SEAT CONTROL VALVES FOR ALL THE PROCESS INDUSTRIES

ANNIN Control VALVES

Send for illustrated Catalog No. 1500-B

THE ANNIN COMPANY
6570 EAST TELEGRAPH ROAD, DEPT. A
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It pays to get EVER-TITE *Quality* in Quick Couplings

Superior quality forged body —precision machined
Uniform wall thickness —no weak spots
Extra heavy reinforcing rim for longer service life
Extra Hi-Strength forged handles —greater economy
Steel pins —greater safety and longer service
Uniform heavy wall thickness —no weak spots
Recess retains gasket in coupler and assures proper placement
Superior quality forged body —precision machined —accurate tolerances

There's an EVER-TITE for every need

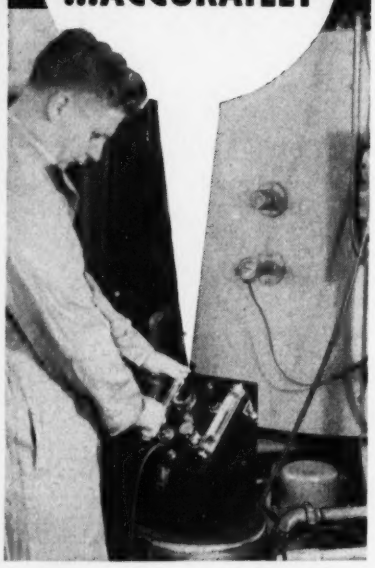
EVER-TITE Couplings give you a quick, tight connection every time—under every condition. They make your deliveries fast . . . safe . . . dependable. And because they are made of tough, durable bronze, they give you *more* coupling service—*less* coupling cost.

It pays to get EVER-TITE quality—the top value in quick couplings. Ask your distributor.

EVER-TITE Couplings assure
Speed
Safety
Economy

EVER-TITE COUPLING CO. INC., 254 W. 54 ST., NEW YORK 19

read dew points INSTANTLY ...ACCURATELY



The Alnor Dewpointer takes the guesswork out of dew point readings... makes it easy, even for non-technical personnel, to achieve consistent accuracy. That's because fog is suspended in an enclosed chamber, under controlled conditions which can be reproduced time after time... anywhere. This means faster readings, too, with no time lost calculating variables. And the Alnor Dewpointer is completely self-contained, requires no external coolant or auxiliary apparatus. It operates on either a.c. or the enclosed battery. Available in three ranges... for dew points between – 20°F. and room temperature, from – 80°F. to – 0°F. and from – 80°F. to room temperature. For more information, send for your copy of the Alnor Dewpointer Bulletin. Illinois Testing Laboratories, Inc., Room 559, 420 North La Salle Street, Chicago 10, Illinois.

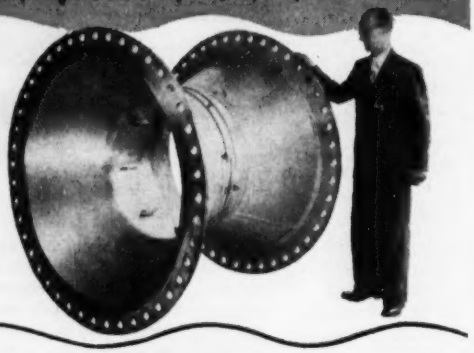
Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

FOR *FLOW MEASUREMENT*

only the Gentile FLOW TUBE manufactured by* **FOSTER** *offers you all these* **ADVANTAGES:**

*Gen-til-'ly



ACCURACY – Produces differential from points of equal cross-sectional area . . . furnished with head capacity curves, and guaranteed for exceptional accuracy when used with any standard indicating, recording or integrating meter.

LOW HEAD LOSS – Available in several types and D/d ratios to provide differentials that can be accurately measured with least head loss.

LOW INSTALLED COST – Average length is only 1½ times the pipe diameter, and straight runs entering and following are not required unless installed near throttling valves or regulators.

Write for Bulletin FT-101 or specific recommendations

75 YEARS OF EXPERIENCE

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Synthetic Fabrics and Yarns

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To sell America's most demanding buyers . . . specify ENJAY

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Methyl Ethyl Ketone
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Isopropyl Acetate
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Isopropyl Ether
Dicyclopentadiene
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Decyl Alcohol
Denatured Ethyl Alcohol

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PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
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Isoprene
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Meet America's most important consumer. The woman whose judgment makes or breaks a sale in more and more fields today. She buys the look, wear, work and performance of a product . . . she demands *proved results.*

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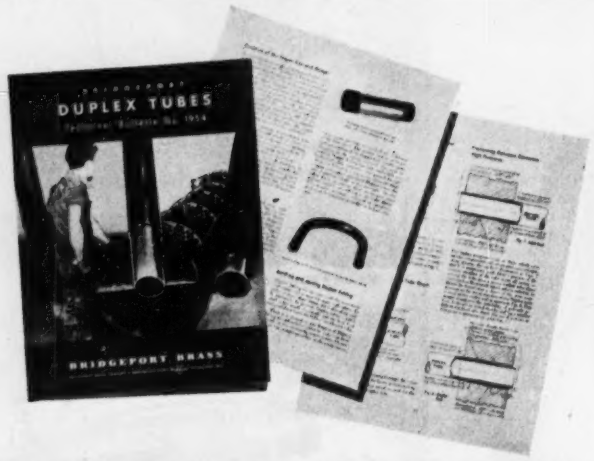
BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

Bridgeport BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



To Answer Your "Double" Corrosion Problems

Many heat transfer installations must stand up under corrosive attack from two different media at the same time . . . one inside and one outside the tubes. In many applications, tubing of a single metal cannot withstand this double onslaught for very long. The answer is found by combining two metals, each highly resistant to one of these corrosive conditions, into a Duplex tube.

● The story of Bridgeport Duplex Tubing, drawn from 15 years of successful service, is now graphically told in Bridgeport's newly published *Duplex Tubes Technical Bulletin No. 1954*. In concise, quick-reading language, supported by ample illustrations and comprehensive charts and tables, this Bulletin describes the most important features of construction, application, selection and installation of Duplex Tubing to profitably solve many double corrosion problems.

Variety of Metal Combinations

Bridgeport Duplex Tubes are supplied in many combinations of ferrous and nonferrous metals, each chosen to resist the particular combination of corrosive media involved.

For chemical plants producing colorless formaldehyde, Duplex Tubing with Admiralty Brass outside for brackish water, and aluminum inside for formaldehyde has made an excellent record. Equal results have accrued in oil refining and natural gas processing with stainless steel outside to resist various corrosive petroleum vapors, and copper or copper alloy inside toward fresh circulating water.

In other applications, Red Brass, Aluminum Brass or Cupro Nickel to the water or steam side, and low carbon steel, nickel, lead, tin, etc., to the product side have been very satisfactory.

Many Products Handled

The list of possible products and their combinations that can be suitably handled by Duplex Tubing is virtually endless. The following are a few of the more common items:

Ammonia	Food Products
Amines	Formaldehyde
Beverages	Formic Acid
Boiler Water	Fruit Juices
Carbonated Liquids	Gums
Carbon Dioxide	Hydrogen Sulfide
Chemicals	Mercury
Coke By-Products	Nitric Acid
Cooling Water	Oils
Compressed Air	Petroleum Products
Cosmetics	Plastics
Drugs	Resins
Dyes	Refrigerants
Explosives	Soaps
Fatty Acids	Steam
Fertilizers	Sulfuric Acid
Flue Gases	Varnishes

Other Advantages

Aside from the unique advantage of custom-tailored corrosion resistance on both sides of your tubes, Duplex Tubes often give better impingement corrosion resistance, higher heat transfer rates, reduced fouling and slime, or higher operating temperatures, depending on the particular metal combination and operating conditions involved.

For example, careful heat transfer tests run on tubes of copper, steel, and copper/steel Duplex showed a higher heat transfer rate by far for the copper/steel Duplex than for the tube of steel alone. The tests also showed that in double wall tubes of the same material, there is virtually no reduction in heat transfer across the metal bond. This fact is the result of an excellent mechanical bond between the two concentric metals in Duplex Tubing, assured by Bridgeport's method of manufacture.

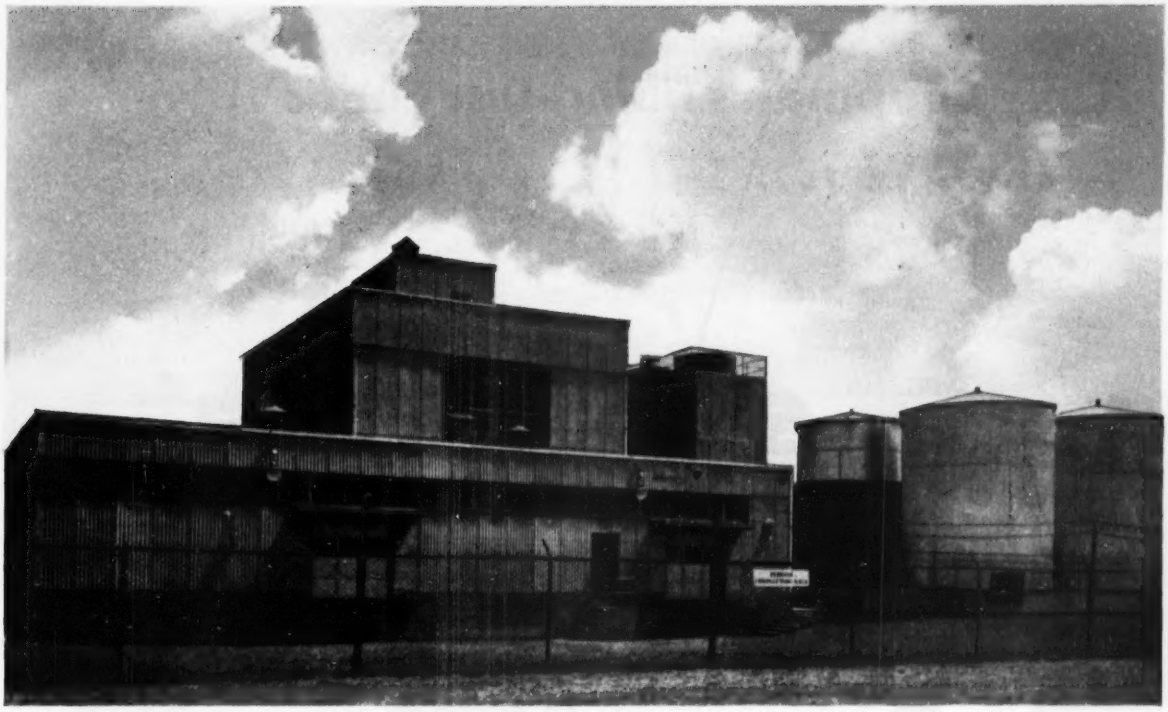
Installation Data

The *Duplex Tubes Technical Bulletin* also contains information on Selection of Proper Size and Gauge of Tubes, End-Annealed Tubes, Overcoming Galvanic Corrosion by Cutting Back Duplex Tubes, Bending and Joining Duplex Tubes, Provision for Thermal Expansion, and Provisions for Reducing Turbulence.

A complete section on methods of installation states that most combinations of Duplex Tubing can be expanded or rolled into the tube sheet in the same way as ordinary condenser or heat exchanger tubes, but offers precautions on several specific types. Detailed cutaway line drawings complete this presentation.

How to Get Your Copy

The Bridgeport *Duplex Tubes Technical Bulletin No. 1954* will be of valuable help in your double corrosion problems. Request your copy today on company letterhead. And for your condenser or heat exchanger tube requirements, or assistance on your corrosion problems, contact our nearest branch office. (1684)



Now... "TONNAGE" OZONE IN CHEMICAL PROCESSING!

Emery Industries' successful operation of their new ozone-oxidation plant brings "tonnage" ozone to the chemical processing industry . . . and also brings proof that ozone-oxidation provides higher yields of purer products at a lower cost.

Emery's unique process for producing their dibasic acid—Azelaic—has been made practical by Welsbach Ozone . . . a truly potent new tool for the chemical processing industry.

Welsbach Ozone is being used more and more in chemical processing to carry out difficult oxidations. Ozone reacts very specifically and very rapidly with carbon-carbon double bonds, all three atoms taking part to form an ozonide which is readily decomposed to produce cleavage at the point of the original double bond.

Welsbach Ozone's unique properties make it outstandingly superior to ordinary conventional oxidants. Because Welsbach Ozone is generated at the point of use, it presents no procurement problems, no storage expense and no materials handling difficulties. No full-time supervision or labor is necessary. Operating costs are constant and predictable, and maintenance costs are negligible. But most important, Welsbach Ozone gives higher yields of purer products at a lower cost.

With "tonnage" ozone an actual fact in chemical processing, *now* is the time for you to try Welsbach Ozone as a solution to your oxidative cleavage problem. The Welsbach Model T-23 Laboratory Ozonator will get you started now . . . and will give you the data to prove that Welsbach Ozone increases profits and lowers costs.

WELSBACH

OZONE IS TONNAGE OZONE

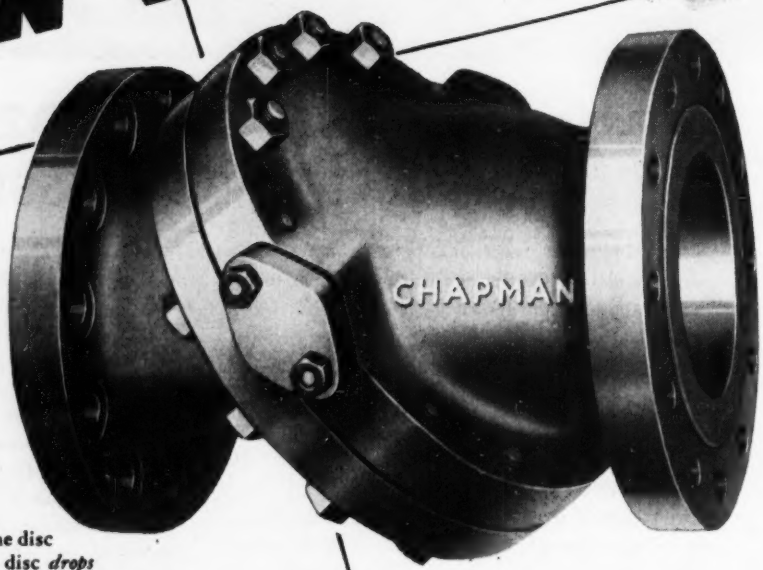
Test Its Potential In Your Own Laboratory—In Your Own Process

THE WELSBACH CORPORATION
OZONE PROCESSES DIVISION
1500 Walnut Street, Philadelphia 2, Pa.

Pioneers in Continuing Ozone Research

Only Chapman's *Tilting-Disc* Check Valves Give You...

NO SLAMMING
LOW HEAD LOSS
LOW WEAR



Here's the check valve that stays open with minimum flow resistance, closes fast without slamming, closes tight without sliding or scraping wear.

Cushioned Closing

Pressure against the upper part of the disc cushions it as it closes. Then the disc *drops tight* to its beveled seat after the valve has swung closed. Both actions are fast, but they are fluid-cushioned. Seating is quiet in all but unusual piping arrangements.

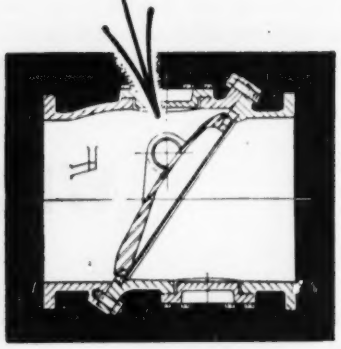
Low Flow Resistance

The streamline design of the valve body and disc eliminate turbulence and cut flow resistance. The fluid holds the disc tightly against its stops, without flutter. The body is larger around the disc, so the net valve area is at least as much as the pipe area.

Minimum Wearing Action

Because the disc *drops* tight, it doesn't slide against the seat. The wear on hinge pins is small because the disc doesn't flutter. Unusually husky construction in every detail means long life under the toughest conditions for Chapman's Tilting Disc Check Valve.

Full engineering and construction data are in Chapman's Catalog #30. Write for it now.

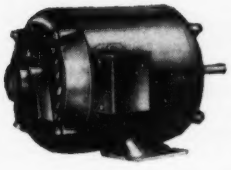


Here's Why CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

The CHAPMAN VALVE
Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

Choose Century MOTORS



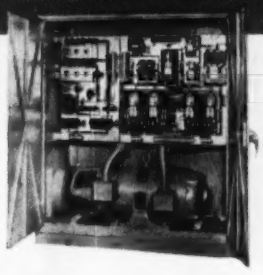
SINGLE PHASE:

Split Phase Induction—⅛, ¼, ½ H.P.

Capacitor—⅛ to 20 H.P.
Repulsion start, brush lifting, induction—½ to 7½ H.P.

Write for Bulletin Nos.:

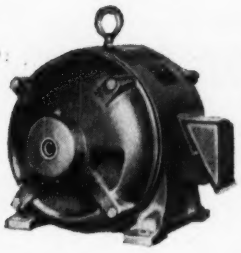
Split Phase 1-5P1
Capacitor 1-1P3
Repulsion Start 2-1P1



SELECTIVE SPEED DRIVE:

A complete line of adjustable speed drives for coordinating all kinds of production processes.

Write for Bulletin No. 11-1P1



POLYPHASE:

Squirrel Cage Induction—⅛ to 400 H.P.

Wound Rotor Motors—1 to 400 H.P.

Synchronous Motors—20 to 150 H.P.

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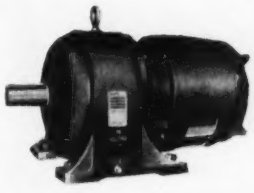
Squirrel Cage, Drip Proof—6-1P1
Squirrel Cage, Splash Proof—6-1P3
Squirrel Cage, Enclosed Fan Cooled—6-1P41
Squirrel Cage, Explosion Proof—6-1P45
Wound Rotor—6-3P1



GEAR MOTORS:

⅛ to 15 H.P., single, double and triple gear reduction.

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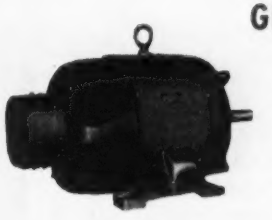
⅛ to ¾ H.P. . 4-5P21-61
1 to 15 H.P. . . 4-1P31

DIRECT CURRENT:

All capacities—⅛ to 300 H.P.

Write for Bulletin No. 10-1P1



GENERATORS:

AC, .63 to 250 KVA
DC, .75 to 200 KW

Write for Bulletin Nos.:

AC, .63 to 250 KVA—18-1P21
DC, .75 to 200 KW—18-1P1

CE-825R

Motors listed above are available in Open Rated Drip Proof, Splash Proof, Totally Enclosed Fan Cooled and Explosion Proof frames—and with a dozen different methods of mounting. They are unusually quiet starting and running and unusually free from vibration.

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for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

JENKINS

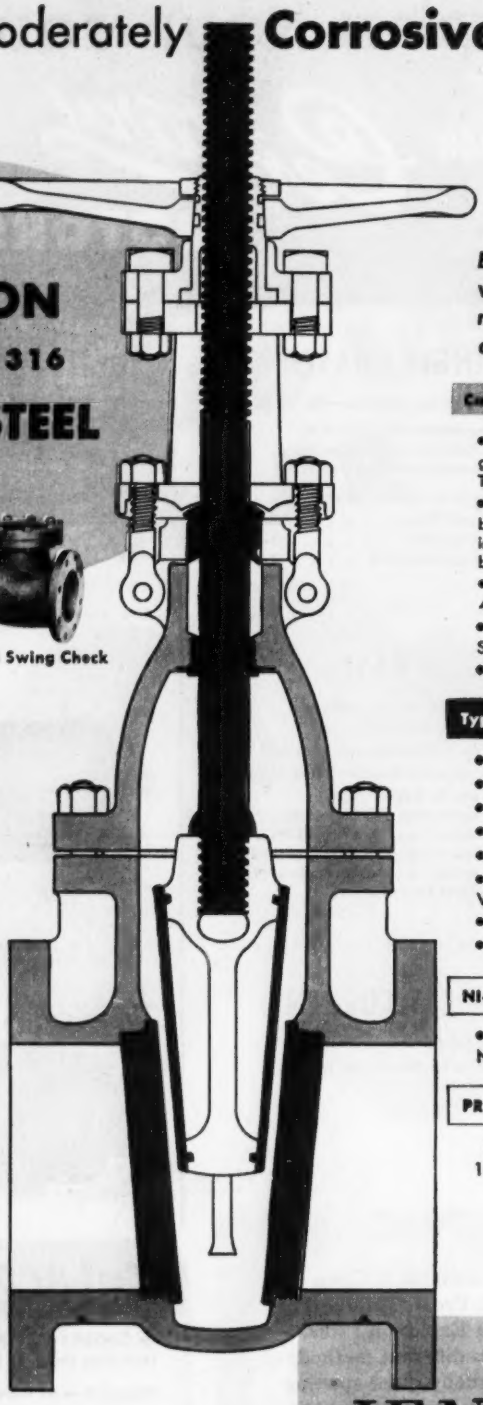
NICKEL IRON

Valves with Type 316

STAINLESS STEEL

Trim

Fig. 2624 Swing Check



Every part in contact with fluid is the right metal to block corrosion and beat wear.

Cast NICKEL IRON

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2″ to 4″ sizes.
- **WEDGE** In 10″ to 24″ sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10″ to 24″ sizes.
- SEAT RINGS
- DISC and HANGER in Check Valve

NI-RESIST Type No. 2

- WEDGE of I-beam structure is solid NI-RESIST in 2″ to 8″ sizes.

PRESSURE RATINGS

2″ to 12″—200 lbs. O.W.G.
14″ to 24″—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros

Engineered for endurance

THE TUBE-TURN Welding Neck Flange is the preferred choice for most severe piping services—resulting from high pressures, temperature extremes, or numerous fluctuations of substantial amount in either temperature or pressure or both. Due to its long-tapered hub which affords a smooth transition in thickness, the welding neck flange assembly has an endurance strength equal to that of pipe joined by butt welds.

You can fill all your requirements for Welding Fittings and Flanges from TUBE TURNS' complete line. For prompt, efficient service, call your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

The Leading Manufacturer of Welded Fittings and Flanges

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A Division of National Cylinder Gas Company

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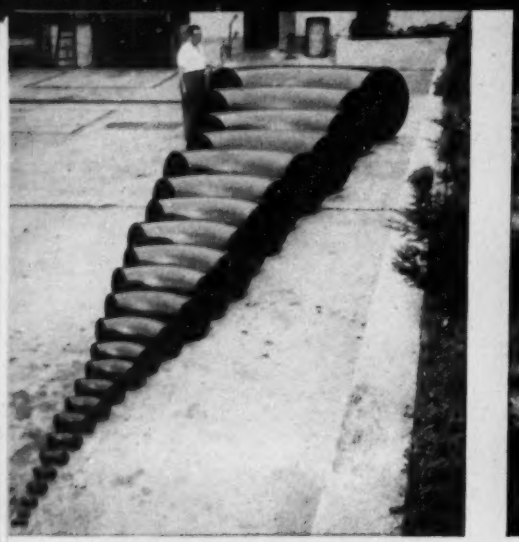
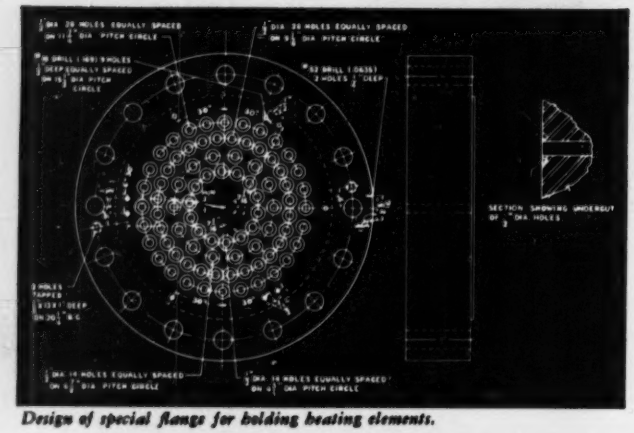
ENGINEERING SERVICE



YOUR NEEDS *in welding fittings and flanges are met efficiently and quickly by your nearby* TUBE TURNS' *Distributor. There are more than 4000 items in the complete line of* TUBE TURNS' *products. Example: carbon steel elbows from ½" to 42" diameter as shown.*

SIMPLIFIES JOB. *The uniform wall thickness and true circularity of* TUBE-TURN *Welding Elbows makes possible accurate fit-up when cut to odd angles for jobs such as the 16" gas line shown.*

Your problems solved by TUBE TURNS' ENGINEERING SERVICE



Design of special flange for holding heating elements.

MOST FLANGE NEEDS in industrial piping are filled by TUBE TURNS' ASA line of various types, sizes and materials. However, there are many exceptions . . ."specials" such as these: (1) lens ring flanges for use at 5300 psig and 400°F, with test pressure of 10,600 psig; (2) flanges in sizes from 14" through 72" for use at 30 psig and 400°F max.; (3) 2" flanges for high vacuum service at 400°F—950°F, and (4) various complex sheet tube flanges.

A "special" example is shown at the left, developed by TUBE TURNS' Engineering Service Division for E. L. Wiegand Co., Pittsburgh. It has 84 holes for heating elements. Flanges must withstand hydrogen-nitrogen mixture at 1000 psig at 750°F and 3000 psig at atmospheric temperature.

TUBE TURNS IS AT YOUR SERVICE!

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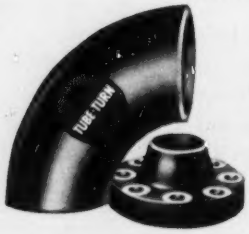

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

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TUBE TURNS

LOUISVILLE 1, KENTUCKY

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

Another new development using

B. F. Goodrich Chemical *raw materials*

B. F. Goodrich Chemical Company does not make these shoe covers. We supply the Geon paste resin for the coating only.

Shoe Fashions at Oak Ridge

YOU MIGHT laugh at yourself the first time you wore these shoe covers, but their purpose at an Oak Ridge Atomic Energy Plant is no laughing matter.

These canvas shoe covers help prevent the spread of radioactive contamination. Workers slip them on over their shoes when entering a contaminated area. They are made of canvas, with the walking surface coated with a plastisol based on Geon paste resin.

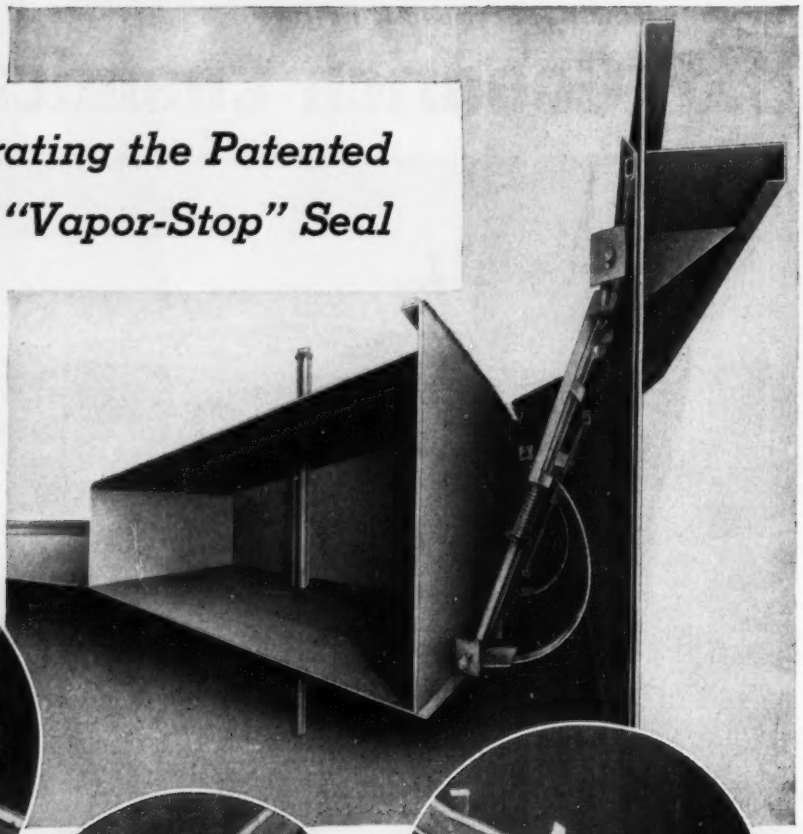
They are thoroughly flexible, and the Geon coating gives them a tough, abrasion-proof surface. The cost of these shoe covers is low despite their important use—thanks to Geon! Maybe this unique use for Geon may help you improve or develop more saleable products, for Geon-based plastisols and other Geon materials have helped build sales for many products—such as colorful upholstery, wire insulation, rigid paneling and tubing and many more.

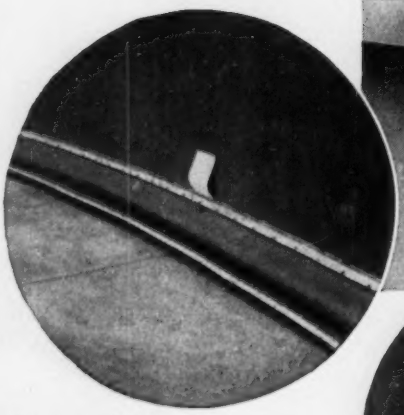
Check with us; we'll help you select the Geon material best suited to your product's requirements. For technical information, please write Dept. GE-4, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable

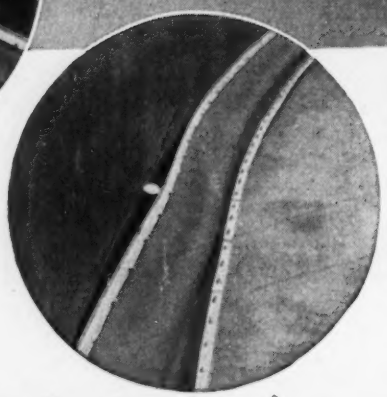
GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

Demonstrating the Patented GRAVER *"Vapor-Stop" Seal*

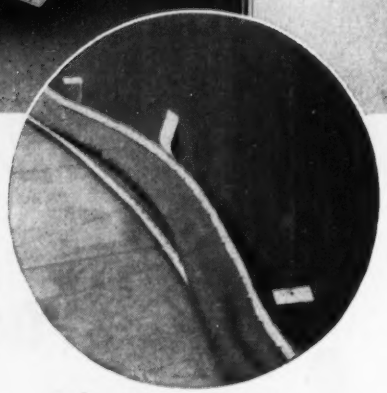




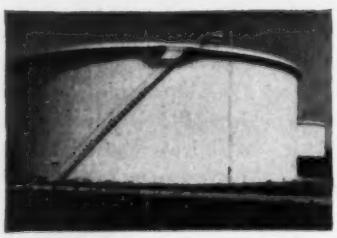
it's tight! As seen above, the Graver "Vapor-Stop" Seal provides a firm closure between the roof and tank shell—so tight that a piece of paper will not slip through.



it's sensitive! Despite its effective closure, the sealing mechanism is so sensitive it does not break the egg shown above, indicating the friction-free, long-lasting performance that the seal provides.



it's flexible! The seal is free to move over obstructions, yet continues to close the gap and prevent loss of vapors. It is successful on both converted tank shells and new construction.



The seal mechanism is an integral part of all Graver Floating Roof designs, including the Double-Deck Floating Roof tank and the Center-Weighted Pontoon and Pan-type Floating Roof tanks.

This patented seal is the key to the successful functioning of Graver Floating Roof tanks. Composed of two mechanisms—a weighted arcuate pusher and a spring-actuated hanger, it acts as a "Vapor-Stop," preventing loss of volatile vapors. The seal provides positive centering action for the roof. It also prevents the entrance of air and rain, and resists corrosion.

Simple and foolproof, it eliminates the need for multiple seals. The mechanisms are completely covered, and the fabric is asbestos coated with Neoprene, impervious to vapors. Graver's "Vapor-Stop" Seal is fire-resistant and Underwriters' Laboratories approved.

GRAVER

...a specific conservation design to fit every need.

GRAVER TANK & MFG. CO., INC.

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CLEVELAND • PITTSBURGH • HOUSTON • CATASAUQUA, PA.
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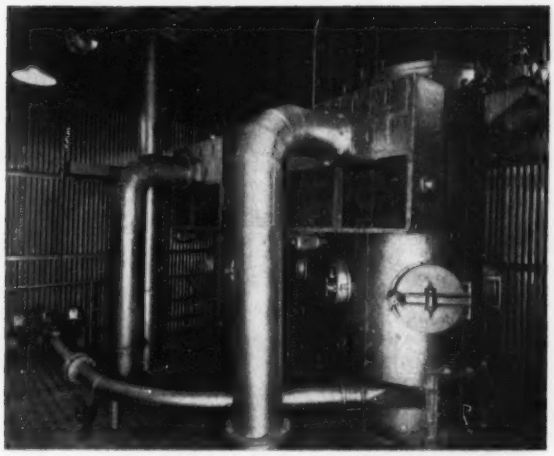
LOS ANGELES • EDGE MOOR, DEL. • TULSA

3 big benefits

from The AIRVEYOR® at Western Electric



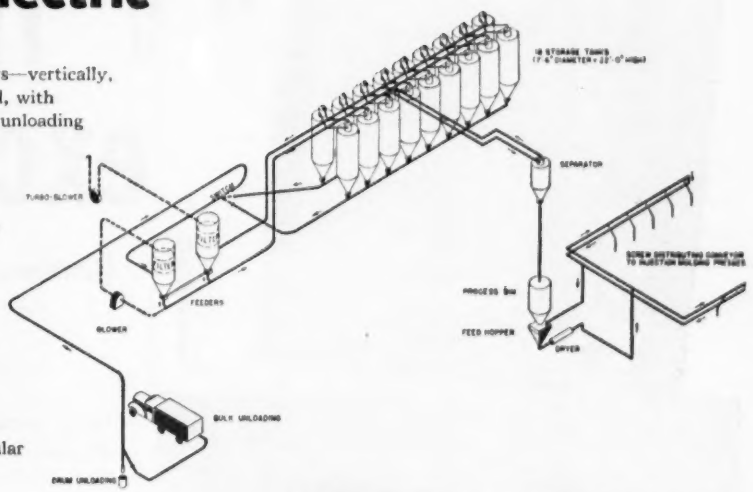
Four compartment, continuous Airveyor filters

1 The Airveyor moves plastic powders—vertically, horizontally, around corners, overhead, with centralized push-button control—from unloading to storage and processing.

2 Seals dust in—contamination out. Prevents explosions, avoids respiratory hazards.

3 Cleanliness all along the handling route—without spillage—to multiple points of storage and use.

The Airveyor has all these advantages for handling dry, pulverized and granular materials.



The Western Electric Company plant in Indianapolis can now handle up to 10,000 pounds of plastic powders an hour, with all the advantages listed above. The Airveyor system of piping extends nearly 400 feet.

You may not be handling plastic powders—but most dry, pulverized and granular materials can be conveyed better, at less cost, and without contamination with the Airveyor.

Write today for further information—and preliminary engineering studies—for handling your dry process materials.

Bulk unloading from truck, using the Airveyor

Fuller

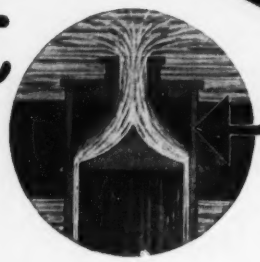
FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St.—Chicago 3
420 Chancery Bldg.—San Francisco 4

**DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—
COMPRESSORS AND VACUUM PUMPS—
FEEDERS AND ASSOCIATED EQUIPMENT**

A-145
1675

Dirty Water can't "Shut-down"...

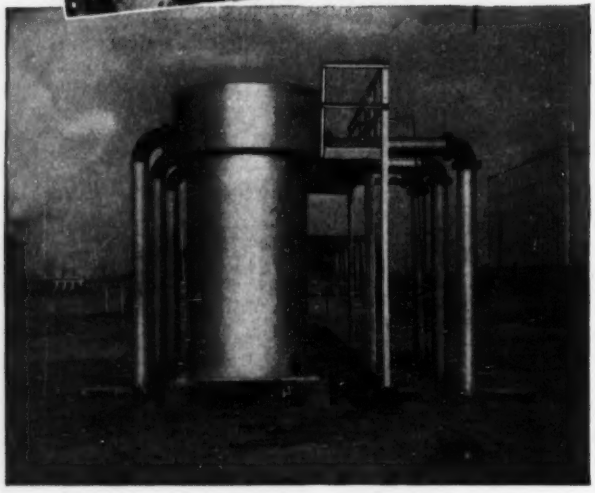
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

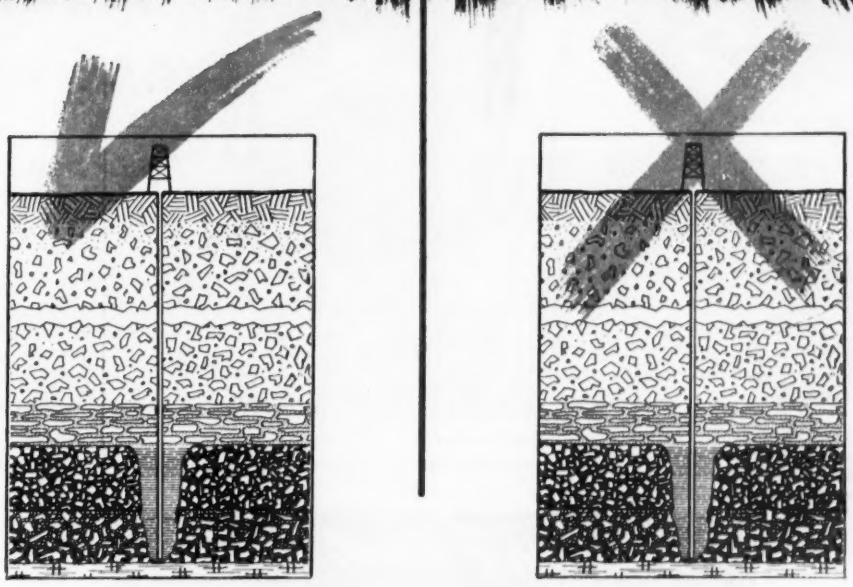
[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

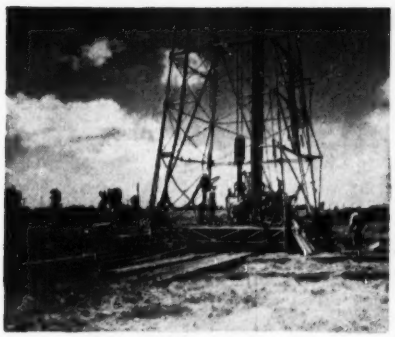
SULPHUR

...why can't *Every* dome produce sulphur?



The production of sulphur in the Gulf Coastal Region of Louisiana and Texas by the Frasch Process, is from underground natural beds found in "domes." However, very few domes have been found to contain sufficient sulphur, if any, to be brought into production.

It is estimated that nearly 200 dome structures along the Coast of the Gulf of Mexico have been investigated over the last half-century but only fourteen have produced sulphur in quantity.



And the presence of sulphur, even in quantity, doesn't always mean a successful producer. Some years ago a dome was found, explored, and proved with the result that a plant for the production of sulphur was erected at a cost of several million dollars. Later it had to be abandoned because the underground conditions did not lend themselves to the use of the Frasch Process.

A dome is a sulphur mine only when it can be worked economically and produce sulphur in commercial quantities.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

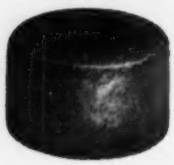
Sulphur Producing Units

- **NEWGULF, TEXAS**
- **MOSS BLUFF, TEXAS**
- **SPINDLETOP, TEXAS**
- **WORLAND, WYOMING**

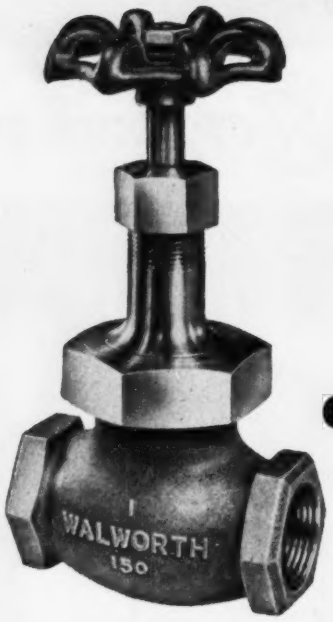
WALWORTH

Toothed Lock Washer: Prevents loss of stem nut due to vibration, thereby holding the handwheel securely.

Newly Designed Handwheel: Air-cooled, finger grip handwheel affords sure grip even with greasy gloves.



Improved Packing: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure.



IMPROVED
No. 95
BRONZE
GLOBE VALVE

also available in Angle Type (No. 96)

The service ratings of the Walworth No. 95 are 150 pounds per square inch steam at 500F, and 300 pounds per square inch non-shock cold water, oil, and gas. In the manufacture of this quality bronze valve, more than 47 gages are used in machining parts to micrometric accuracy, thus insuring interchangeability of parts. For further information see your local Walworth distributor, or write: Walworth Company, 60 East 42nd St., New York 17, N. Y.

note these 7 Great Features

Hexagonal Union Bonnet Connection: Eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and assembled.

WALWORTH
valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

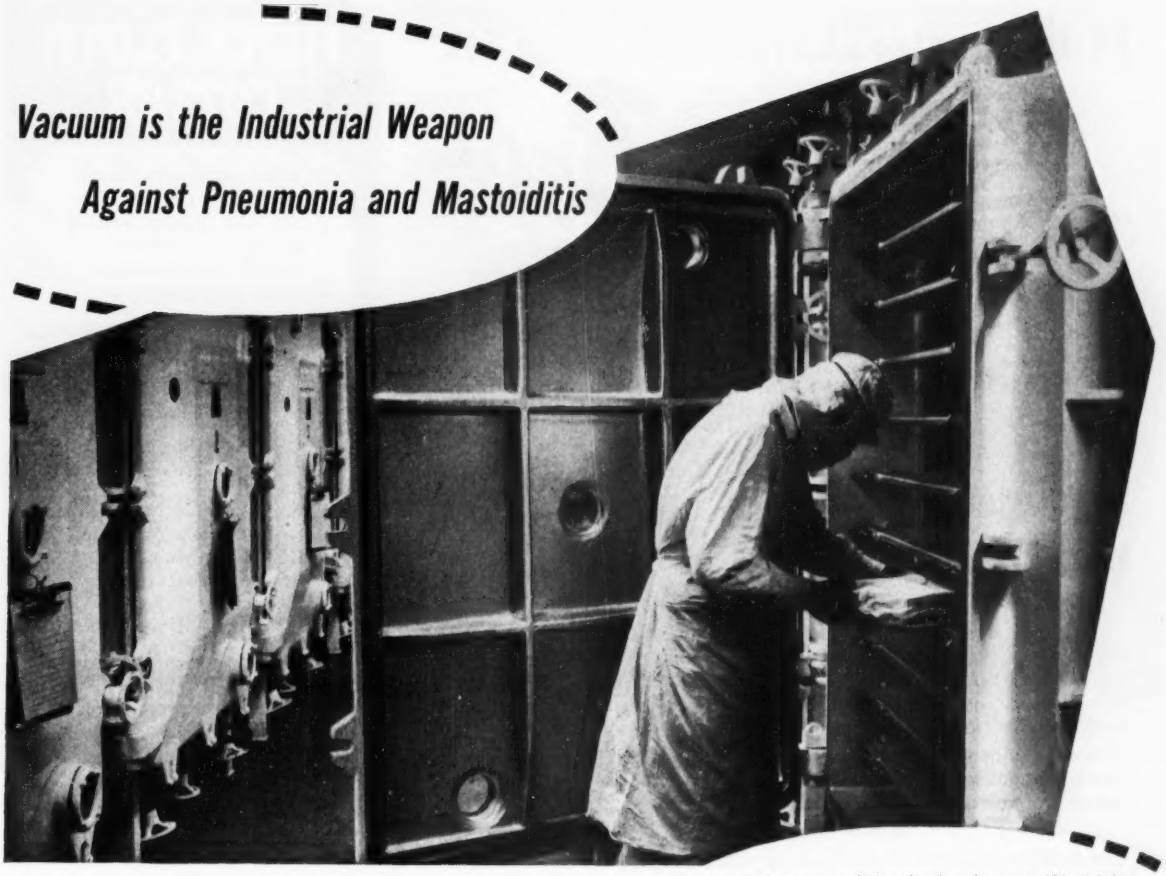
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

New Cylindrical Disc Holder: The design of the top portion of the disc holder keeps the disc accurately guided under all operating conditions.

Renewable Asbestos Disc: This disc is suitable for steam up to 500F and is resistant to oil, gasoline, and many chemicals at atmospheric temperatures. Discs for special services are available.

Extra Strong Body: Made of Composition M (ASTM B61) bronze thick enough to provide a high safety factor. Valves undergo hydrostatic shell test of 450 psi.

Vacuum is the Industrial Weapon Against Pneumonia and Mastoiditis



Stokes vacuum drying chambers in use at Abbott Laboratories, North Chicago, Ill., for the drying of crystalline penicillin and other antibiotics. Picture is taken through window of sterile drying room. Operator is masked and gloved to maintain sterile conditions.

Remember when these were dreaded afflictions? Now mastoid troubles are a rarity and pneumonia is no longer a dreaded killer, thanks to penicillin. Penicillin, dried in Stokes vacuum chambers at Abbott Laboratories, North Chicago, Ill., is one of many pharmaceuticals which must be dried under vacuum because only under vacuum are the destructive effects of air and heat avoided.

Vacuum drying — in many cases from the frozen state — is also the drying method for blood plasma, mycins, hormones, antibiotics, anti-venoms and biologicals.

For many industrial chemicals, vacuum drying is the efficient, low-cost high production method for removing water and recovering valuable solvents safely.

Stokes experts have 50 years of experience in vacuum processing to share with interested manufacturers. Send for any or all of the following informative brochures:

(1) Freeze-Drying in Industry,
(2) Laboratory Freeze-Drying,
(3) Vacuum Drying.

F. J. Stokes Machine Company
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STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment

Your Spectrophotometer is at its Best when input line is regulated by Sorensen!

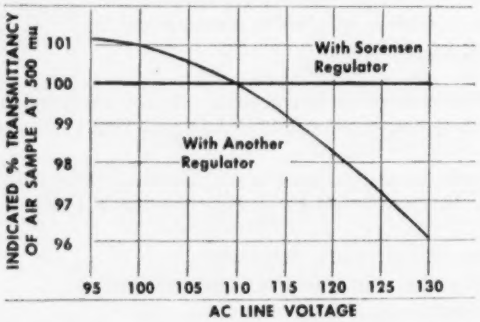
A scientist, working with a spectrophotometer in a government laboratory, recently asked us to cure a condition of instability which was preventing his making accurate or reproducible analyses with the instrument. Despite the use of another type of regulator, line voltage variations were causing random fluctuations of the spectrophotometer meter.

This was readily understandable. The light source of the spectrophotometer was an incandescent lamp, and lamp intensity is an extremely sensitive function of voltage, being expressed by the formula

$$\text{Lamp Intensity} = KE^{3.5}$$

The existing regulator arrangement allowed voltage variations of $\pm 1\%$, resulting in lamp intensity variations of approximately 7%—sufficient to seriously affect readings.

Sorensen's fully satisfactory solution was to replace the other regulator with a Sorensen Model 500S AC Line Regulator. This instrument has a regulation accuracy of $\pm 0.1\%$ with nearly instantaneous recovery time, and effectively eliminated line voltage variations as a source of significant error. A comparison of the spectrophotometer operations under the two input arrangements is plotted below.



With scientists' and technicians man-hours at a premium, the small investment required to provide a stable input line to power delicate and costly laboratory instruments represents true economy. We invite your inquiry concerning the application of Sorensen electronic power controlling devices to your particular problems. Write directly to Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. In Europe, correspond directly with Sorensen A. G., Gartenstrasse 26, Zurich 2, Switzerland.

SORENSEN

SORENSEN & CO., INC., 375 FAIRFIELD AVE., STAMFORD, CONN.

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FOR PLATE & FRAME PRESSES
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MADE TO REQUIRED SIZE

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ACID & ALKALI RESISTANT TO
MOST CORROSIVE SOLUTIONS
DUST COLLECTION BAGS—
ALL TYPES FABRICATED TO
MEET SPECIFICATIONS
WRITE FOR SAMPLES, SUBMIT DETAILS

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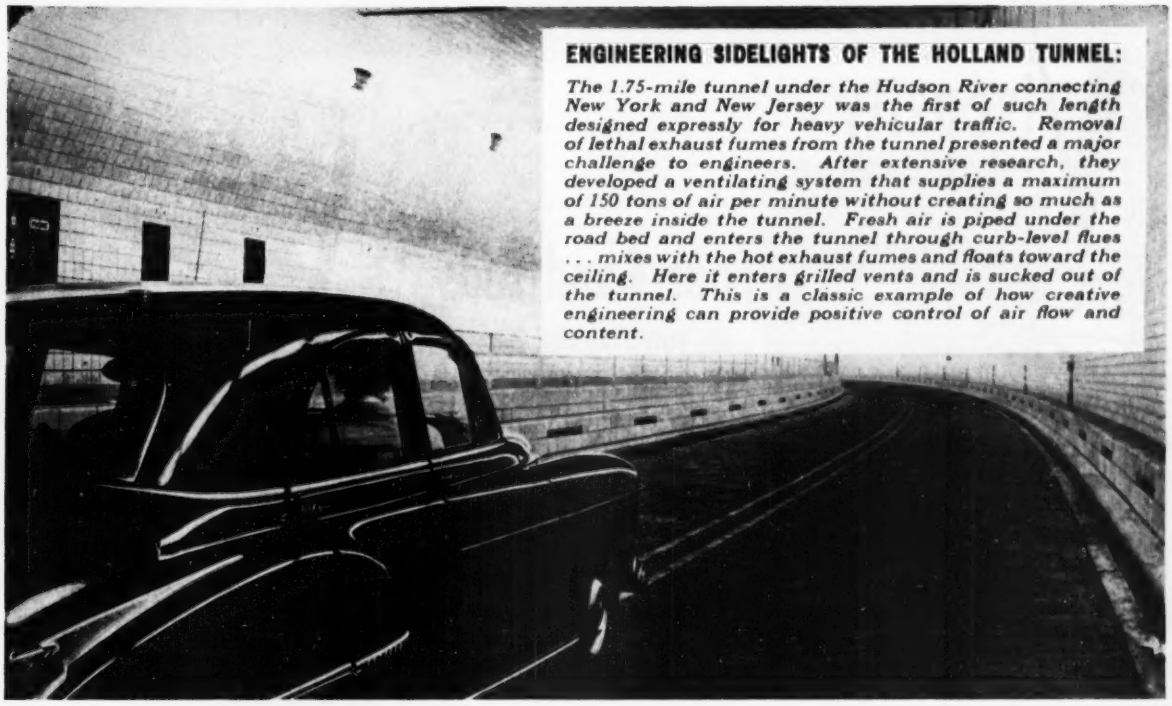
FOLDER

SHOWS HOW

1 man can move
3 tons of material in
60 seconds with

a B-G CAR UNLOADER

see your B-G distributor or write
Barber-Greene
AURORA, ILLINOIS, U.S.A.



ENGINEERING SIDELIGHTS OF THE HOLLAND TUNNEL:

The 1.75-mile tunnel under the Hudson River connecting New York and New Jersey was the first of such length designed expressly for heavy vehicular traffic. Removal of lethal exhaust fumes from the tunnel presented a major challenge to engineers. After extensive research, they developed a ventilating system that supplies a maximum of 150 tons of air per minute without creating so much as a breeze inside the tunnel. Fresh air is piped under the road bed and enters the tunnel through curb-level flues . . . mixes with the hot exhaust fumes and floats toward the ceiling. Here it enters grilled vents and is sucked out of the tunnel. This is a classic example of how creative engineering can provide positive control of air flow and content.

Control is the Important Feature in Traylor Rotary Kiln Design

With a Traylor Rotary Kiln, coordinated control of all the factors entering into thermo-processing assures an efficient flow of material timed to the specific requirements of your product. This is the result of Traylor's practice of engineering each kiln to specifications set by you . . . the customer. This, plus the fact that there's over half a century of engineering know-how behind each Traylor Kiln, assures you of superior quality control and increased output. In addition, Traylor experience gives you the bonus features of adjustable kiln supports and single section rigidity of all-welded steel sheels . . . assuring alignment that cuts maintenance costs and reduces power requirements. Put this experience to work on your particular problem. Although each Traylor Kiln is built to individual specifications, bulletin 1115 illustrates and gives a general description of Traylor's many design features. Send for your free copy today.

TRAYLOR ROTARY KILNS ARE USED FOR THE PROFITABLE PRODUCTION OF MANY DIFFERENT PRODUCTS SUCH AS:

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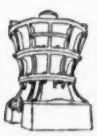
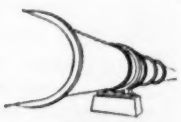
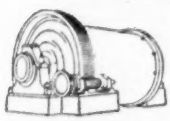
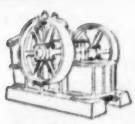
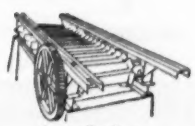

Primary Gyratory Crushers


Rotary Kilns

Secondary Gyratory Crushers


Ball Mills


Jaw Crushers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Viscosity directly in centipoises

WITH SLIDE-RULE ACCURACY & SPEED

Brookfield

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VISCOMETER

Portable
Use in Lab,
Plant or both

Just a flick of a switch, then read the dial, and with a Brookfield Viscometer on the job you have your viscosity determination directly in centipoises. The whole operation, including cleaning up, takes only a minute or two.

High accuracy *plus* high sensitivity are inherent in the Brookfield principle of operation — direct indication through a calibrated spring of the torque on a rotating spindle. Changes in viscosity as small as 1/5 of 1% of scale can be observed.

Ideal for use both in Labs and at points-of-process, Brookfield Viscometers plug in any ac outlet and are ruggedly constructed — have withstood the severest of service conditions the world over.

ADAPTABLE TO ANY PROBLEM FROM 1 TO 32,000,000 CPS.

Available in a variety of models — single speed, four speed, eight speed, explosion-proof, etc. — Brookfield Viscometers are suitable for work with both Newtonian and non-Newtonian materials.

They have become the standard instrument for nearly every type of viscosity determination problem, including such difficult ones as cream style corn and 2500°F. molten slag.

Accessory equipment such as the Brookfield UL Adapter makes possible measurements within .02 centipoises in the ultra-low viscosity range of .8 to 10 centipoises.

The Brookfield Helipath Stand (another accessory) makes possible precise testing of highly plastic materials such as grease, putty, shaving cream, gelatin, shortening, etc.

Send for fully illustrated 1954 Catalog. Gives full details on all models and accessories. Write today to Dept. C.

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STOUGHTON, MASSACHUSETTS

If the problem is Viscosity Control or Determination — ASK BROOKFIELD

Four Good Aids
ARE NOW AVAILABLE FOR
One Tough Job

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Data & Methods . . . techniques, tricks and shortcuts . . . "six-tenth" factor, correlations, turnover ratios, payout time, capital ratios . . . equipment, plants, labor, utilities, maintenance . . . vibrating screens, instruments, tanks, process vessels, screw conveyors, centrifugals, piping. 38 articles, 128 pages. ($1.75)

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Data & Methods . . . cost language, labor correlations, "quickie" technique, graphical risk factors, engineer's view of the dollar, control by kilowatts, where estimates go sour . . . ejectors, blowers and fans, mixers, pipes and piping. 12 articles, 48 pages. ($1)

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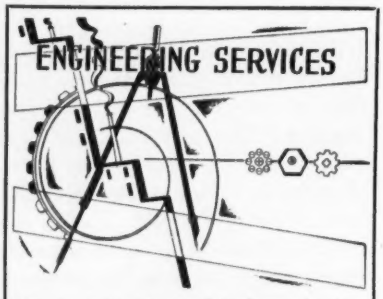

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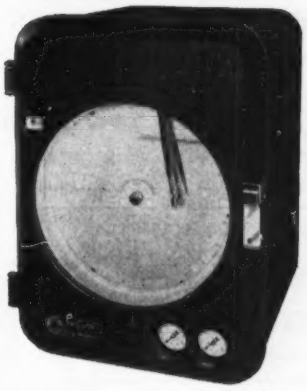

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4—Louisville steam tube Dryers 6'x50', 6'x30', 5'x28', 3'x20'.
4—Devine single door vacuum Shelf Dryers having 20, 14, 6 and 4—40"x43" shelves.
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1—Single Drum 4'x9' Flaker.
4—Buflovak double drum 60"x144", 42"x90", 36"x84", 32"x52".
1—Buflovak 32"x52" double drum 316 SS.
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2—Oliver Monel 8'x10' Rotary-Vacs.
1—Oliver SS 8'x10' Rotary-Vac.
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3—Oliver 5'3"x3' Rotary Vacuum Enclosed Precoat.
8—Oliver Rotary Vacuum 11'6"x18', 11'6"x14', 8'x12', 8'x10', 8'x8', 8'x6', 3'x1'.
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2—Sweetland #12 with 72 and 36 leaves.
1—Sweetland #7 with 27 leaves.
1—Sparkler #33-S 17 steel filter.
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1—Shriver 36" P&F 42 chambers.
8—Sperry 24" P&F, 16 chambers.
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3—Shriver 18" Recessed, 30 chambers.
2—Sperry Aluminum 30" and 24" P&F.
1—Shriver rubber covered 30" P&F.
10—Shriver, Sperry Filter Press Skeletons 42", 36", 30", 24", 18".

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1—Fletcher 40" Suspended, Stainless Steel.
2—Bird 40" Suspended, rubber covered.
1—Tolhurst 32" Suspended, rubber covered.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
2—Tolhurst 30" center slung steel.
1—Bird 36"x50" solid bowl, stainless.
4—Bird 36"x72", 36"x50", 18"x28" solid bowl, continuous
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2—Sharples C-27, C-20, Stainless Steel Super-D-Hydrators.
1—Patterson 40"x84" Gyratory Sifter, single deck, Stainless Steel.
1—Devine 2'x4' Vacuum Drum Dryer 316 S.S.
1—2800 gal. Horizontal Tank with coils, 316 S.S.
4—Abbe 6'x10' porcelain lined, jacketed, Pebble Mills.
2—Raymond 5 and 3 Roll High Side Mills.

PULVERIZERS—CRUSHERS

4—Hardinge Mills 4½'x16", 5'x22', 5'x36", 6'x22" 10"x48".
1—Bauer 36' Attrition Mill 2-50 HP mtrs.
6—Patterson 6'x8', 5'x6', 4'x5', 2½'x3½' brick-lined Pebble Mills.
5—Abbe 3'x4', 3'x3½' Pebble Mills.
2—Premier Colloid Mills 8" dia., SS.
1—Eppenbach QV-8 Colloid Mill 2 HP.
1—Jeffrey 30"x24" Hammer Mill, Type A.
2—Raymond #1 Impact Mills with 5'6" dia. double whizzer separators.
3—Raymond, Gayco Separators 12', 8', 6'.
4—Mikro #1S1, #1SH, #2DH.
2—Sturtevant 5"x8" Roll Crushers.

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SCREENS—CONVEYORS

1—Patterson single deck 40"x96" SS.
5—Stainless single deck 40"x84".
1—#42 Rotex double deck 40"x84".
2—#12 Rotex double deck 20"x48".
5—Tyler Hummer 3'x5' triple deck.
4—Tyler Hummer 4'x15', 4'x10', 3'x10' 3'x5', single deck with V-16 Vibrators.
2—Allis Chalmers 2'x6' and 2'x4'.
1—Abbe #2 Blutergess Sifter.
100 feet 9" and 12" screw conveyor.
8—Bucket Elevators, steel housing 34' to 60' centers, 8"x5", 10"x6" buckets.

MIXERS

5—Baker Perkins 200, 100, 50, 1 and ½ gal. sigma blades, jacketed.
1—Baker Perkins 50 gal. JEM, 50 HP.
1—Baker Perkins, 35 gal. SS jcktd.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
4—Simpson Intensive Mixers #0 and #00.
8—New Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gal. Pony.

KETTLES—STILLS CONDENSERS—TANKS

2—Pfaudler Reactors glass lined 1000 and 500 gal.
6—Buflovak, Zaremba and Kilby Evaporators 300 to 14,000 sq. ft.
1—4' dia. Column, copper and stainless.
9—Heat Exchangers, SS 50 to 1000 sq. ft.
5—Buflovak Condensers 20 to 90 sq. ft.
3—Groen 125 gal., SS, jcktd., agitated Kettles.
1—2800 gal. 316 SS Tank with coils.
3—2300 and 1400 gal. Aluminum Tanks.
6—Glass-lined Storage Tanks 6000 and 8000 gals.

MISCELLANEOUS

7—Stokes Vacuum Pumps 10 to 100 CFM.
10—Stokes DD2, DS2, D4, D3, B2 and R Tablet Machines.
5—Nash TS12, TS8, L3, AL672, #4 Vacuum Pumps.
2—Cumberland #0 Rotary Cutters.
4—Olivite, Durion rubber and stainless steel Centrifugal pumps 1" to 6".

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1—8' O.D. x 61'6" stainless steel, 15 trays, design pressure 50#, design temperature 300°F.
1—7'6" O.D. x 55'6' steel, 30 trays, design pressure 45#, design temperature 300°F.
1—7' I.D. x 42' steel, 20 trays, design pressure 40#, design temperature 150°F.
1—7' I.D. x 25'6" stainless steel, 10 trays, design pressure 50#, design temperature 250°F.
1—7' O.D. x 5' O.D. x 70'4½" steel, 35 trays, design pressure 64#, design temperature 300°F.
1—6' I.D. x 64' steel, 35 trays, design pressure 55#, design temperature 300°F.
1—6' O.D. x 63' steel, 35 trays, design pressure 55#, design temperature 300°F..
1—6' O.D. x 54' stainless steel, 15 trays, design pressure 74#, design temperature 350°F.
1—6' I.D. x 45' stainless steel, 15 trays, design pressure 850#, design temperature 350°F.
1—5' O.D. x 61'6" steel, 15 trays, design pressure 55#, design temperature 300°F.
1—4' O.D. x 110'6" stainless steel, 70 trays, design pressure 75#, design temperature 300°F.
1—4' O.D. x 72' steel, 40 trays, design pressure 55#, design temperature 300°F.
1—3'6" I.D. x 63' steel, 35 trays, design pressure 55#, design temperature 250°F.
1—2'6" I.D. x 60' steel, 35 trays, design pressure 55#, design temperature 300°F.
1—2' O.D. x 75' steel, 45 trays, design pressure 55#, design temperature 300°F.
1—2' I.D. x 73' steel, 50 trays, design pressure 70#, design temperature 300°F.

HEAT EXCHANGERS—CONDENSERS

2—1440 sq.ft., 304 S.S., 75# PSIG, 350°F.
3—1345 sq.ft. steel, 70# PSIG, 300°F.
1—1270 sq.ft. steel, 55# PSIG, 350°F.
2—1250 sq.ft. steel, 45# PSIG, 350°F.
2—1125 sq.ft. steel, 850# PSIG, 900°F.
2—1125 sq.ft., 304 S.S., 55# PSIG, 450°F.
1— 750 sq.ft. steel, 60# PSIG, 350°F.
10— 715 sq.ft. 304 S.S., 850# PSIG, 550°F.
13— 715 sq.ft. 304 S.S. 75# PSIG, 300°F.
1— 660 sq.ft. steel, 55# PSIG, 350°F.
6— 477 sq.ft. 304 S.S., 850# PSIG, 550°F.
11— 447 sq.ft. 304 S.S., 300# PSIG, 400°F.
1— 400 sq.ft. 304 S.S., 75# PSIG, 350°F.
24— 358 sq.ft. 304 S.S., 75# PSIG, 300°F.
1— 340 sq.ft. steel, 55# PSIG, 185°F.
1— 260 sq.ft. 304 S.S., 300# PSIG, 400°F.
3— 150 sq.ft. 304 S.S., 850# PSIG, 150°F.
11— 108 sq.ft. 304 S.S., 300# PSIG, 300°F.
1— 110 sq.ft. steel, 300# PSIG, 200°F.
1— 100 sq.ft. 304 S.S., 70# PSIG, 350°F.
1— 83 sq.ft. 304 S.S., 100# PSIG, 400°F.
3— 80 sq.ft. 304 S.S., 75# PSIG, 350°F.
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2—Union Iron Works Boilers 30,000# steam per hour, 225# W.P. with oil and gas burners, all accessories.
5—Clark Air Compressors, gas engine driven, Model RA-8. 800 BPH, 2 and 4 stage.
2—Oliver 8'x10' Monel, Rot. Vac. Filters.
2—±12 Sweetland Filters 36 leaves.
2—Sperry 24"x24" c.i. Filter Presses, 31 chambers.
2—Bird 36"x50" continuous Centrifuges, rubber covered.
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1—MIXER, Day No. 6 Single Arm, ss. (new)
5—FEEDERS, Model F22 Syntron Vibro-Flow, with controls. (new)
2—KETTLES, 50 gal., ss., Steam Jacketed, with Double-Acting Agitators. (new)

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1—Louisville steam tube pilot size, s.s.
1—6x40 Direct Heat
1—6x50 Louisville Steam Tube
1—Grupe 5'x22, steam tube
2—5½'x7 & 60' Rotary Kilns
1—6'x35' Louisville steam tube
1—Davenport #3A bronze rotary Press

Centrifugals and Clarifiers

1—32" Tolhurst suspended rubber perf. basket
1—18" Tolhurst susp. steel perf.
1—40" Tolhurst suspended rubber covered perforate basket
2—De Laval 54-81 Clarifiers, 3 hp.
3—Sharples airtight clarifiers, stain. steel
1—Evaporator, Buflovak ss. .163 sq. ft.

Evaporators and Vacuum Pans

1—Evaporator, Buflovak ss., 163 sq. ft.
1—60 sq. ft. 316 SS Single Effect
1—Alberger 1500 sq. ft. SS Condenser
1—Peebles triple effect, stain. steel
1—20 gal. Stokes st. steel Vacuum Pan
1—Swenson sgl. eff. Evap. 120 sq. ft.
1—Swenson quad. eff. Evap., 350 sq. ft.
1—Zaremba trip. eff. Evap. 150 sq. ft.
1—Swenson trip. eff. Evap., 850 sq. ft.

Filtration Equipment

12—Cast Iron recessed and plate and frame Filter Presses, 7" to 36"
1—Oliver Filter 1x1', 316 stain. steel
1—Aluminum 30" 40-chamber P&F. press
1—Lead 24" 38-chamber P&F. press
1—Oliver 8x14' Filter
1—Oliver pressure, iron, 110 sq. ft.
5—Aisop, Lomax internal pressure Filters, stain. steel and bronze

MILLS

1—Hardinge 36" x 5' continuous Pebble Mill
1—Jeffrey 35 hp. Hammer Mill
1—Williams 518 No-Nife Hog
1—Rotary Cutter, No. 1½ Ball & Jewel
1—Williams type AK 40 hp. Hammer Mill
3—Mikro Pulverizers: #18H, 18I
1—Attrition, Sprout-Waldron 20"
12—Pebble and Jar Mills, 1 to 235 gal.
5—Colloid Mills and Homogenizers
1—Raymond 5-roll high side
10—Hammer Mills, ¾ to 50 hp.
6—3-roll Mills, Day, 12x32" and 16x40"

MIXERS

2—50 gal. s.s. Kettles, dbl. act. agitators
1—Day 1 bbl. stain. steel, single arm, jacketed, vacuum cover 3 hp.
2—Day Pony Mixers, 40 and 15 gal.
1—Abbe Lenart 5 and 110 gal.
1—Colton #6 s.s. Granulating
1—Readco 250 gal. work. cap. stain. steel dbf. arm, 50 hp.
7—Baker-Perkins, Read, Lynn-Superior double arm, up to 100 gallons.
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1—Robinson 18" & 22" Attrition Mills.
1—Lehman 4 Roll W. C. 12 x 36" Steel Mill.
5—Steel 3 Roll Mills 8 x 22 to 16" x 40".
1—9" x 36" Double Steel Roller Mill.
1—9"x24" 3 pr. high steel Roller Mills.
3—Houchin 18 x 36", 4 Roll Granite Stone Mills.
Abbe & Sprout Waldron Rotary Cutters.
2—U. S. & Premier 1½ H.P. Colloid Mills.

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5—American Tool 300 gal. Churns.
Horiz. Mixers single & double arm to 200 gal.
4—Day 8, 15 & 40 gal. Pony Mixers.
1—Century 2 HP, 4 speed Vert. Mixer.
6—Lead & Paste Mixers 50 to 150 gals.
1—Tyler 3' x 5' Vibratory 2 Deck Screen.
Patterson 42" dia. Stainless Conical Blender.
1—Master Drum Type Blender 1000#.
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12—Portable Elec. Agitators ¼ to 2 H.P.

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165 CFM Smith 110SR Semi-Portable, 25 HP
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211 CFM 9 x 9 Worthington HB, 40 HP Elec.
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3—Baffle Plate or Cascade Columns or Towers, T304 stainless steel, 5' dia. x 50' high.
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3—Aluminum Bubble Cap Columns, 36 dia. x 45 plate; 27" dia. x 18 plate
1—Aluminum Perforated Plate Column 28" x dia. x 36 plate.
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1—Steel Shell & Tube, 1000 sq. ft.
3—S.S. Coil Condensers, 40 & 55 sq. ft.

FILTERS

2—International T304 St. St. #3 (24" dia.) and #5 (33" dia.)
1—Sweetland #10, 21 leaves, 3½".
1—Sweetland #12, 72 leaves, 2".
1—Swenson Rotary Continuous Vacuum Filter; Precoat type, 8" dia. x 8' face, rubber covered and lead acid proof.
1—FEINC Aluminum Rotary Vacuum string discharge, 4'6" dia. x 6'.
4—Pressure Leaf Filters, 70 to 140 sq. ft.
1—Shriver 36" C. I. P&F., 20 ch. cl. dly.
1—Louisville 8-roll Continuous Filter or Grains Press, 24".

KETTLES—REACTORS

3—13 gal. Autoclaves, T347 St. St., 700# int. WP., 50# Pkt. WP.
1—St. St. T304 Pressure vessel, 18" dia. x 9'4" long, 600# W.P.
2—450 gal. Stainless Steel Kettles, Jktd. & Agit.
70—Stainless Steel and Stainless Clad open top, steam jacketed kettles—40, 60, 80, 100, 150, 500 gal. sizes.
4—Aluminum Reaction Kettles, Jktd. & Agit., 35, 60, 100 gal. and 250 gal.

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1—Kennedy Van Saun 3' x 6' Air Swept Contin. Ball Tube Mill.
1—Williams Hammer Mill type AK; size A, stainless steel and aluminum.

JUST PURCHASED

1—6' D x 8' L Pebble Mill, Porcelain Lined.
3—Horiz. Double Ribbon Mixers—280, 100 & 50 cu. ft. work. cap.
1—St. St. shell & tube condenser, 79 sq. ft.
1—Stokes Jacketed Rotary Vacuum Dryer, 3' dia. x 15' long.
1—Buflovak 5' D x 12' L Vacuum Drum Dryer.
1—Shriver Filter Press, 30", 24 chambers, open delivery.
1—Monel Tank, 3500 gal., 6' dia. x 16' H; 3/16" & ¼"
2—Stainless Steel Vertical tanks 6000 gal.; 10' D; ¼" & 7/16"
1—Stainless Steel Packed Column, 14" D x 25' H
1—Ribbon Powd. Mixers, 280 cu. ft.
1—Fitzpatrick Model D-6 Comminuter, St. St., 15 HP motor.
1—Resina Auto. Screw Capper, for pt., qt. and gal. cans.

TANKS

30—Aluminum Tanks closed, 4, 275, 330, 480, 500, 1350, 1450, 2300, 2700, 3000, 4100 and 9000 gal.
50—Horizontal Welded Steel Tanks from 3800 gal. to 13,700 gal. sizes.
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8—15,000 gal. Vertical Welded Steel Closed Fermenting Tanks, 80 lbs. WP., turbine agitator with 40 HP motor; 970 lin. ft. 3" pipe coil. Excellent condition.

STAINLESS STEEL TANKS

3—T347 Pr. or Vac.—50 & 235 gal.
2—T316 Pr. or Vac.—35 & 160 gal.
11—T304 Pr. or Vac.—2½, 9, 150, 160 & 260 gal.
1—T304 600# pr.—86 gal.
50—Stainless Steel Storage Tanks—from 15 gal. to 8200 gal. sizes.
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Roots-Connersville	57	AF	3	200
Roots-Connersville	22 x 36	RCDH	6	1500
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Roots-Connersville	10 x 12	RCD	10	310
Roots-Connersville	14 x 10	RCD	10	950
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Spencer	1015	15	2,000	16
Spencer	1215	15	1,675	20
Ingersoll-Rand	FS-377	85	15,000	20
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Sturtevant	DES 1	70	SS	56

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1—Stokes-Rotary Tablet Machine, Model #DDS-2.
2—Tolhurst Rubber Covered 40" Suspended type Centrifuges with perforated baskets.
1—Pfaudler glass lined jacketed vacuum Reactor, 500 gallon capacity, 75 PSI jacket, 40 lbs. internal pressure.
1—Swenson Walker type 316 Stainless Steel Jacketed Crystallizer. 4-10' Sections.
1—Sparkler Type 316 Stainless Steel Jacketed Filter, Model 33-D-17.
1—Sparkler Stainless Steel Jacketed Filter, Model 18-D-8.
1—Bird-Young Stainless Steel Filter, 3' x 3'.
1—Niagara Stainless Steel Filter, Model 136-46.

THE GELB GIRL — APRIL, 1954

DRYERS—KILNS

1—Stokes Rotary Vacuum Dryer, 3' x 12'.
1—Vulcan Rotary Kiln, 7' x 120'.
1—Buflovak Double Drum Dryer, 32" x 90".
1—Louisville Steam Tube Dryer, 6' x 50'.
2—Buflovak Vacuum Drum Dryer, 24" x 20".
1—Devine Rotary Vacuum Dryer, 5' x 25'.
1—Buflokak Double Door Vacuum Shelf Dryer, 20 shelves each.
1—Louisville Experimental Laboratory Dryer, 12" x 7½'.
9—Devine Vacuum Shelf Dryers, 5, 9 and 10 shelves.

FILTERS

1—Sweetland #2 Stainless Steel Filter, 12-16" Leaves, 28 sq. ft.
1—Schriver 42" x 42" C.I., P.F. Filter Press, 60 chamber, open delivery, with hydraulic closing.
2—Oliver Rotary Vacuum Filters, 5'3" x 6', Steel construction with Monel Screens.
1—Oliver Homogenous Lead Filter, 8' x 8'.
1—Sperry Aluminum Plate & Frame Filter Press, 42" x 42", Closed Delivery, 3" Frames, 35 Chambers.
1—Bird 24" Monel Screen Type Centrifugal Filter.
1—Schriver Stainless Steel Filter Press, 24" x 24", Closed Delivery, 10 chambers.
1—Sperry 42" C I Plate & Frame Filter Press, 16 Chambers, Closed Delivery.
5—Sweetland Filters, #2, 5, 7 and 12.
1—Oliver Rotary Steel Filter, 3' x 1'.

CENTRIFUGALS

1—Tolhurst Solid Curb S.S. 26" Perforated Basket Centrifuge with Explosion Proof Mtr.
1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
2—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Baskets.
6—Sharples #16-Y Stainless Steel Super-Clarifying Centrifuges.
1—Ellis Stainless Steel Centrifuge with 30" Perforated Basket.
1—Type 304 Stainless Steel 132 sq. ft. Heat Exchanger.
1—Sharples Type 316 S.S. Super-D-Hydrator, Model No. C-20.

MIXERS

1—Baker Perkins Stainless Steel Jacketed Double Arm Mixer, Sigma Blades, 9 Gals.
1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 Gals.
5—I.H.P. Explosion Proof Gear Head Mixers with Stainless Steel Type 316 Propellers & Shaft, 445 RPM.
1—Struthers Wells Double Arm "Northmaster" Mixer, 50 Gals. Working Cap., 100 Gals. Total Cap.
5—Simpson #0 Intensive Mixers.
1—Simpson #1 Intensive Mixer.
4—Baker Perkins Steel Jacketed Mixers, Sigma Blades, 100 Gals.
3—Baker Perkins Stainless Steel, Jacketed, Mixers, Sigma Blades, 100 Gals.
3—Turbo Steel Jack. Mixers, 700 Gals. Each.
1—J. H. Day Steel 50 gallon double arm Sigma Blade Mixer.

PULVERIZERS—GRINDERS—MILLS

1—Abbe #00 Rotary Cutter with 3 HP Motor.
1—Mikro #2TH Stainless Steel Pulverizer.
1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
1—Mikro #3W Pulverizer.
1—Mikro #2TH Pulverizer, Stainless Steel & Bronze Construction with Motor.
1—Abbe #2 Master Rotary Cutter.
1—Ball & Jewel #0 S.S. Rotary Cutter.
2—Ball & Jewel #2 Rotary Cutters.
1—Blaw Knox Air Mill Pulverizer.
1—Mikro Stainless Steel Atomizer #6.
3—Tropp 2-Roll Rubber Mills, 18' x 50".
1—Abbe #2 Buhrstone lined Pebble Mill, 5' x 4'.
1—Gruendler #24-40 Hammer Mill.
1—Kent Laboratory 3 Roll Experimental Mill, 4" x 8".
1—ISH Micro Pulverizer.

AUTOCLAVES—KETTLES—TANKS

1—Stainless Steel Crystalizing Tank, 6,000 Gallons.
1—Pfaudler 500 Gallons Jacketed Vacuum Reactor.
1—Combustion Engineering Stainless Steel Jacketed Autoclave, 500 Gals. 300 PSI.
2—Pfaudler Glass Lined Jacketed Vacuum Reactors, 200 Gal. each.
1—Pfaudler Glass Lined Jacketed Reactor with Anchor Type Agitator & Drive, Unused, 500 Gallons.
2—S.S. 200 Gal. Jacketed Vacuum Reactors.
1—450 Gal. Stainless Steel Jacketed Kettle.
1—Struthers Wells Steel Jacketed Vacuum Reactor, 1800 Gals. Cap. with Drive, Turbine Agitator & Coils.
1—Buflovak Type 347 Stainless Steel Rotary Vacuum Dryer, 5' x 20'.
1—Baker-Perkins, Steel Jacketed Double Arm Sigma Blades, 200 gallon working capacity. Year built 1948.
1—Link Belt Steel Roto Louvre Dryers, 7½' x 20'.
1—Readco Type 316 Stainless Steel Jacketed Powder Mixer, 1,000 lb. capacity, 125 PSI, ASME.
1—2,800 gallon type 316 Stainless Steel Horizontal storage tank with coils.
1—Readco Type 316 Stainless Steel Powder Mixer, 1,000 gallon capacity.
1—Nooter Stainless Steel Vacuum Reactor, 500 gallon capacity.

12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Each.
1—Monel Storage Tank, 1,300 Gals.
2—Blaw Knox Steel Jacketed Autoclaves, 300 & 500 Gals. P.S.I. Work. Press. 500 lbs.
1—Patterson Steel Jacketed Autoclave, 900 Gals. Cap. Internal Pressure 120 lbs.
1—Artesian Steel Jacketed Kettle, 1,000 Gals. Cap. with Rake Type Agitator, ASME Code, 50 lbs. Pressure.
2—J.P. Devine Jacketed Vacuum Reactors, 2,000 Gals. Cap. Each.
1—Buffalo Steel Pressure Tank, 10,000 Gals. Cap. 125 P.S.I. ASME Coded.
25—Steel Storage Tanks, 9,000-17,500 Gals.
1—Steel Rubber Lined Storage Tank, 4,500 Gal. Cap.
6—Haveg Storage Tanks, 500 & 2000 Gal.
2—Pfaudler Glass Lined 100 Gal. Storage Tanks, Type VR-100.
3—Glascote Glass lined Vacuum Receivers, 25 & 30 Gals. Cap.

MISCELLANEOUS

2—Downington Stainless Steel Heat Exchangers, 500 Sq. Ft. Each.
1—Watson Stillman Hyd. Press, 12" x 12", 30.
1—Nash Hytor Vacuum Pump, Model #H-4 with 25 HP Motor.
1—Roots Connorsville Blower, Model #HD, Size 16" x 12".
3—Nash-Hy-Toor Vacuum Pumps Model No. T.S.-12.
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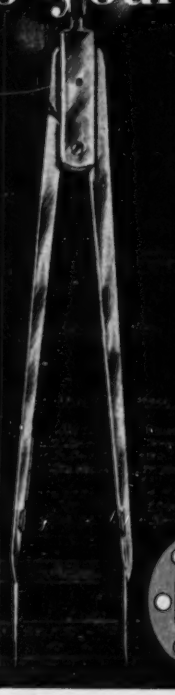

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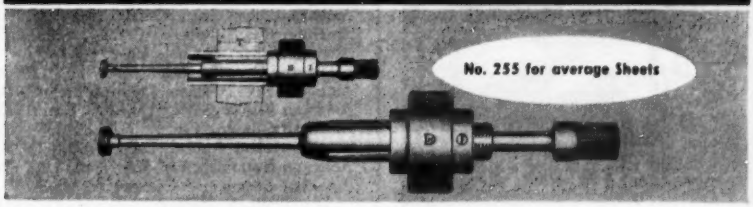

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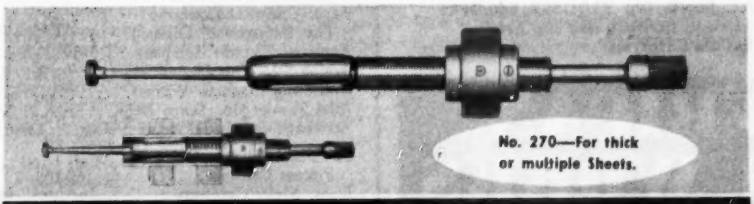

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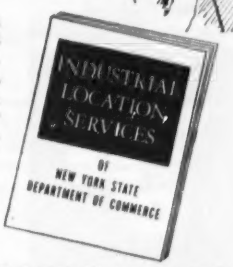

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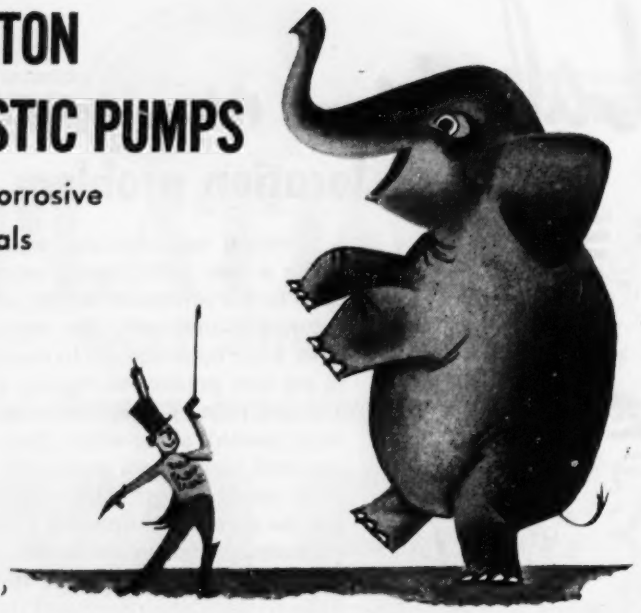
VANTON PLASTIC PUMPS

tame corrosive chemicals



Flex-i-liner **PUMPS** are becoming industry's standard for those difficult to handle corrosive solutions and abrasive slurries, such as HCL, HF, NaOH, H_2SO_4, distilled H_2O, $FeCl_3$, HCOOH, and $Al_2(SO4)_3$, because their unique design eliminates stuffing boxes, shaft seals, gaskets and check valves.

NO METAL IN CONTACT—The only parts in contact with the fluid being pumped are the outer surface of the durable precision molded flexible liner and the inner surface of the pump body block, both of which are available in a wide selection of corrosion and contamination resistant materials.

FLEX-I-LINERS:

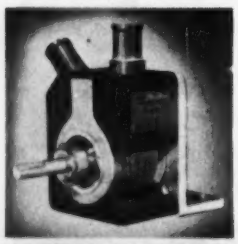
● Pure gum rubber ● Natural Rubber ● Neoprene
● Hycar ● Buna N ● Silicone ● Vinyl ● Compar

BODY BLOCKS:

● Polyethylene ● Bakelite ● Buna N
● Lucite ● Unplasticized PVC

● Available in stainless steel for special applications.

Flex-i-liner Plastic Pump



NO STUFFING BOX—Elimination of stuffing boxes, packing glands and shaft seals, avoids the possibility of external leakage and prevents contamination of the transferred liquid by oil or grease.

SELF PRIMING—Vanton self priming plastic pumps give immediate operation in any position.

GET THE FACTS—Write for bulletin "VP" and the full story of Vanton plastic pumps

OUR CORROSION RESISTANT PRODUCTS FOR FLUID HANDLING include a complete line of Buna N and Natural Hard Rubber centrifugal pumps, valves, pipe and fittings. Bulletin BHR on request.

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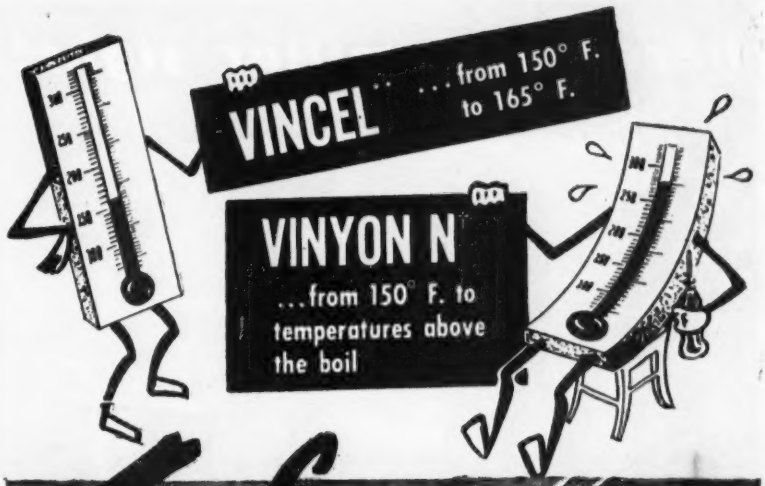

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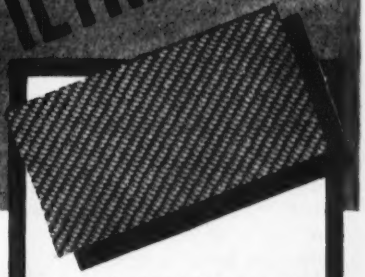

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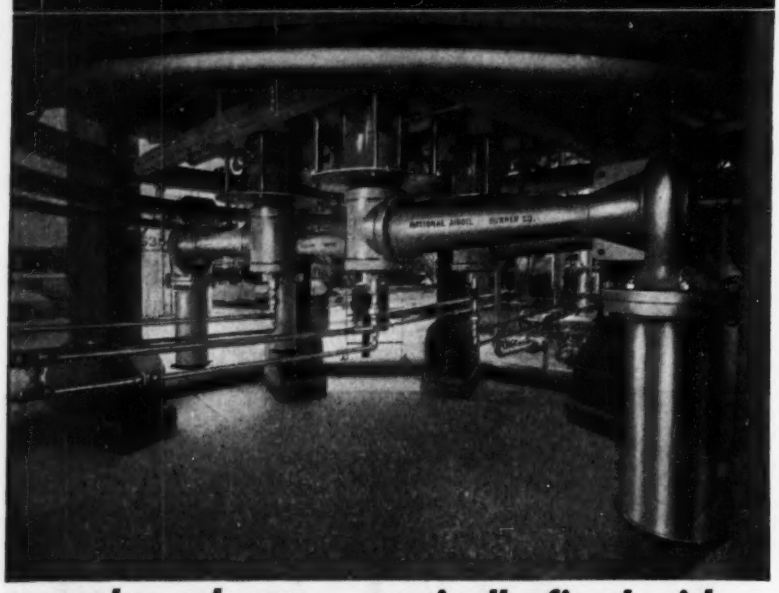

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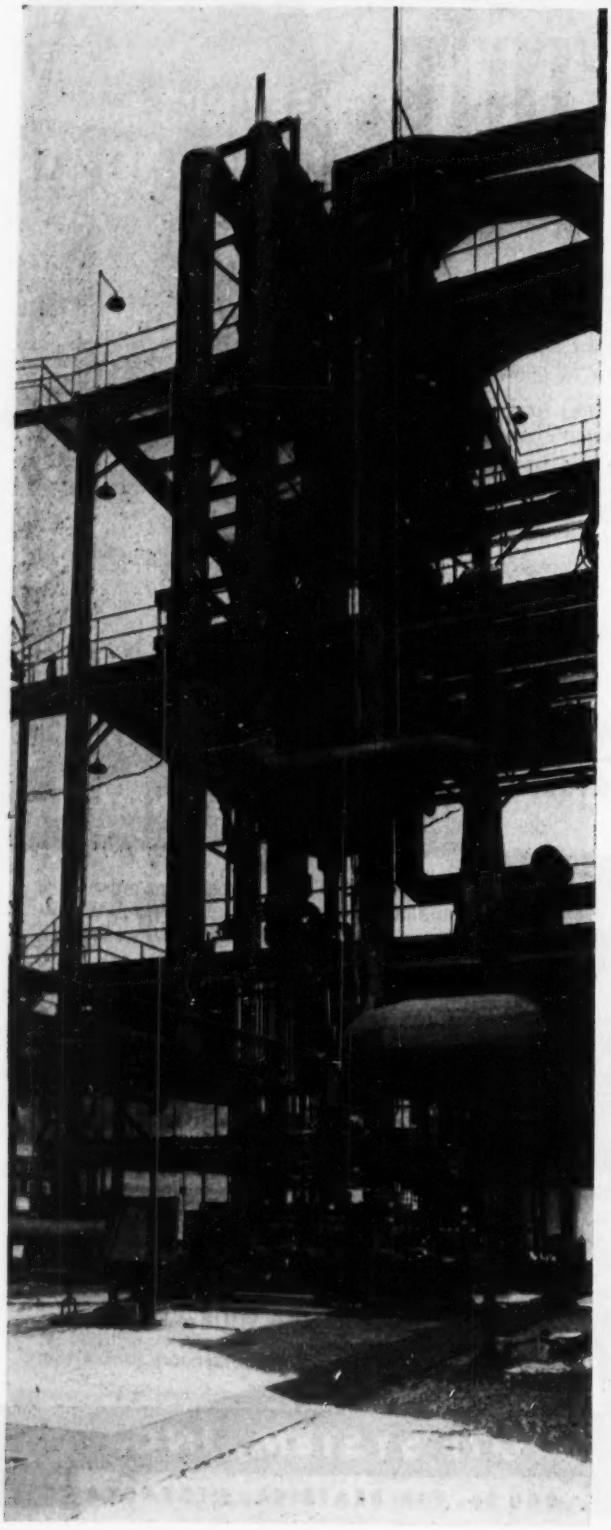

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- **EQUIPMENT**
- **SERVICES**
- **TECHNICAL LITERATURE**

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Chemicals

Acid Anhydrous, Hydrofluoric 88a	40 p. book contains valuable information on hydrofluoric acid anhydrous. Provides useful data for those who now use HF, or for those contemplating its use. Harshaw Chemical Co.
Acids, Fatty 484A	Covers typical composition and specifications for Hydrofol fatty acids. Hydrofol glycerides, Adol fatty alcohols and sperm oil products. Bulletin 906. Archer-Daniels-Midland Co.
Acids, Fatty 484B	Describes three new modified solid acids. Includes information on typical characteristics, possible applications, availability, etc. Technical Bulletin 50. Emery Industries.
Acids, Fatty, Distilled 484C	Ideal for lubricating greases as well as hand cleaners, soaps, etc. Wall chart gives composition & specifications of 40 ADM chemicals from oils & fats. Archer-Daniels-Midland.
Acrylamide 484D	159 p. New Product Bulletin offers technical data on acrylamide; 3-aminopropanol; N-tert-butylacrylamide; N,N-diallylmelamine; triallyl cyanurate; etc. American Cyanamid.
Alcohols, Fatty 484E	Makes available Cachalot fatty alcohol data sheet. This newly-revised data sheet shows typical analyses for 15 types of Cachalot brand fatty alcohols. M. Michel & Co.
Algaecides 484F	Pool algaecide fights & conquers unpleasant, unsanitary microscopic plants. Available in liquid & jelly forms. Data on system to maintain clear swimming pools. Intertol.
Ammonia, Anhydrous 484G	Covers specifications, physical properties, numerous uses, shipping, handling & storage, toxicity, first aid, etc. in Technical Data Sheet 22. Commercial Solvents Corp.
Antioxidants, Food-Grade 484H	New bulletin, "Key to Feed Markets for Animal Fats," has been made available specifically for use by renderers & feed manufacturers. Offers complete details. Eastman Chemical.
Bacteriostat 50-1a	Use in hand soaps reduces resident skin flora. Keeps hands virtually germ-free long after washing & reduces resident skin bacteria up to 97%. Technical Bulletin. Monsanto.
Catalysts 484I	Data on catalysts for producing synthesis gases & hydrogen; for hydrogenation; for selective removal of acetylene; for desulfurization; for oxygen removal. Illustrated. Girdler.
Catalysts, Platinum Metals 33	In many procedures, production control, purity of end product & cost of catalysis are brought to peak efficiency thru use of one of platinum metals catalysts. Covers uses. Baker & Co.
Caustic Soda 77	Effectively standardize processing methods. Inspections & analyses safeguard uniformity of caustic. Data sheets offered. Bulletin 100 describes products & services. Hooker.
Chelating Agents 484J	Extremely stable at high temperatures throughout the pH range, powerful chelating agents are guaranteed for uniformity of chelating power. Technical data. Bersworth Chemical.
Cyclohexylamine 50-1b	Cyclohexylamine is used as a dyestuff intermediate, petroleum additive, component in boiler water treatment, corrosion inhibitor, & in organic syntheses. Monsanto Chem. Co.
Dextran 484K	Covers important applications in pharmaceuticals, adhesives, films, coatings, cosmetics & detergents, & in paper & textile industries. Data on properties. R. K. Laros Co.
m-Dichlorobenzene 484L	Colorless mobile liquid with odor similar to other chlorinated aromatic compounds. Physical & chemical properties, uses, etc. in Product Development Bulletin CB-1. Solvay Process.
o-Dichlorobenzene 484M	Pertinent data on o-Dichlorobenzene (Pure). Covers properties, eutectics, spectrometry, numerous reaction, suggested uses. Product Development Bulletin CB-2. Solvay Process.
Di-Isodecyl Phthalate 158B	Outstanding primary plasticizer for polyvinyl chloride. Covers typical physical & electrical properties, application in polyvinyl chloride, shipping, etc. Bulletin 0-108. Monsanto.
Di-Iso-Octyl Phthalate 480O	An effective primary plasticizer for vinyl resins, & compatible with all common vinyl polymers. Properties & uses in Technical Service Bulletin E-7. Witco Chemical Co.
Dioctyl Adipate 484N	Technical data on DOA, a primary plasticizer which imparts excellent low temperature flexibility to polyvinyl chloride resins and synthetic rubbers. Bulletin O-106. Monsanto Chem. Co.
Di(n-Octyl, n-Decyl) Phthalate 484P	Primary plasticizer imparts low volatility and excellent flexibility to finished compositions. Applications, properties, specifications, etc. Bulletin O-109. Monsanto Chem. Co.
Dioctyl Phthalate 484Q	A colorless high boiling ester of outstanding value as a primary plasticizer for vinyl resins. Describes properties & uses in Technical Service Bulletin E-6. Witco Chemical Co.
Emulsions, Wax 484R	Offer many advantages over solvent systems. Provide properties to meet the needs of many industries more safely and efficiently. Details in 16 p. booklet. Hercules Powder.
Etho-Chemicals 484S	Illustrated, 20 p. covers Ethofats, Ethomids, Ethomeens—unique cationic & non-ionic surface active hemicals. Data on chemical properties, solubility, applications, etc. Armour Chem.
Ethylene Oxide 484T	33 p. offers technical data on ethylene oxide, ethylene glycol & diethylene glycol. Includes uses, properties, handling & storage features, safety precautions. Nitrogen Div.
Ethylene Polymer 152C	Market Development Bulletin covers suggested applications, properties, blends with commercial polyethylene, blends with paraffin and vegetable waxes. Phillips Petroleum Co.
Furfural 484U	28 p. covers properties, uses & shipping data for furfural, furfuryl alcohol, tetrahydrofurfuryl alcohol, furoic acid, etc. Illustrated Bulletin 201-A. Quaker Oats Co.
Glycerine 100a	Important ingredient in many confections, flavoring agents, & other food products. Properties & applications in 16 p. booklet, "Why Glycerine for Foods?" Glycerine Producers' Assoc.
Glycerine 100b	Many properties make it preferable for toilet preparations. Safe for use in pharmaceuticals. Offers booklet. "Why Glycerine for Drugs and Cosmetics?" Glycerine Producers' Assoc.
Herbicides 50-1c	Can be applied in wide variety of soils & climatic conditions to control weeds. Gets results by acting thru soil to kill germinating weed seeds. Data Sheet. Monsanto Chemical Co.
Isopropyl Acetate 484V	Data on physical & physiological properties, applications, specifications, shipping, resin solubilities, constant boiling mixtures, etc. Bulletin F-8295. Carbide & Carbon.
Methylamines 484W	Due to their low cost & low equivalent weight . . . they are ideal sources of basic organic nitrogen. Used as intermediates for many products. Offers technical data. Rohm & Haas.
Oils, Essential 484X	26 p. catalog supplies information on essential oils, balsams, concentrated flavors, oleoresins, basic perfume oils, etc. Includes data on personnel. Magnus, Mabee & Reynard.
Pigments, Iron Oxide 399	Reduce grinding and dispersing time in paints and allied products as much as 75%. Physical & chemical specifications and suggested applications. VVF Tech Report. C. K. Williams & Co.
Plasticizers, Low Temperature 158A	Auxiliary low temperature plasticizer for polyvinyl chloride. Includes physical properties and a comparison of auxiliary plasticizers in polyvinyl chloride. Atlas Powder.
Polyols 156B	Data on non-crystallizing plasticizing polyol for moisture-conditioning. Covers physical properties, advantageous characteristics, applications, shipping, etc. Atlas Powder.
Polyvinyl Acetate Water Emulsions 484y	For use in adhesive textile, paper, leather & paint industries. Feature uniform quality, excellent stability, wide compatibility, high bond strength, etc. PVB 502. Colton Chemical.
Resins, Ion Exchange 393	Nalcite cation and anion exchange resins perform with a dependability and efficiency that command confiidence throughout the industry. Bulletins 57, 58, 60. National Aluminate.
Sequesterants 484Z	Data on TEAC-90, new type organic salt derived from selected acids & amines. Covers use as sequesterant, antioxidant, agricultural aid, etc. Bulletin 1-54. Process Chem.

Soaps & Synthetic Detergents 484AA — New 1954 Handy Soap and Synthetic Detergent Buying Guide offers full resume of entire line of industrial products. Includes use, packaging data, etc. Colgate-Palmolive.

Sodium Hex-m-Phosphate 485A — Covers properties, analysis & applications in industrial processes: powerplant & municipal water treatment; textile wet-processing, etc. Illustrated Bulletin C-1001. Westvaco Chem.

Sodium Sulfonates 485B — Have become active components in a surprising variety of products. Data in technical bulletins, "Sodium Sulfonates, Refined (62%)" & "Shell Pale OS Sulfonates." Shell Chem.

Sodium Trimethoxy Borohydride 485C — Sodium trimethoxy borohydride is most powerful selective reducing agent for certain functional groups where steric hindrance is present. Data in Bulletin 504-C. Metal Hydrides.

Solvents, Petroleum 485D — Buyers' guide to petroleum solvents and their properties. Lists aliphatic naphthas, paraffinic hydrocarbons & aromatic hydrocarbons & solvents. American Mineral Spirits Co.

Stabilizers Lead Compound 156D — New lead compound developed for stabilizaaion of halogen containing organic materials. Covers composition, specific gravity, solubility, etc. in Bulletin S-8. Witco Chem.

Tetrachlorobenzenes, Isomeric 485E — Exhibit unique physical & biological properties that make them useful in specific industrial applications. Data in Product Development Bulletin CB-4. Solvay Process.

Trichlorobenzenes, Isomeric 485F — Includes data on physical properties of the pure isomers; volatility, solubility, etc.; various reactions; suggested uses. Product Development Bulletin CB-3. Solvay Process.

Urea, Crystal 247 — Laboratory pure crystal urea at process prices. Purity comparable to U.S.P.—in 100 lb. moisture-proof multiwall bags . . . in carload, truckload, L.C.L. quantities. Nitrogen Div.

Vinyl Processing 485G — Data on lubricating action of A-C Polyethylene & comparison between this material & more common release agents now used in processing of vinyl sheeting & film. Semet-Solvay.

Wetting Agents 50-1d — Uses include laundering, paper rewetting, industrial cleaning compounds, detergent sanitizers and textile processing. Offers details in AJ Bulletin P-147. Monsanto Chem. Co.

Xanthine Compounds 485H — Latest data on xanthine, hypoxanthine & sodium xanthine. Covers physical & chemical properties & applications in biochemistry & medicine. Bulletin 114a. Schwarz Labs.

Zirconia, Stabilized 396 — Information on the development of a new, patented process in which each zirconium crystal is stabilized. Details in Folder L-8816. Zirconium Corp. of America.

Process Equipment

Absorbers 170-1f — For absorption of hydrogen chloride and other gases. Produce up to 20 tons per day 22° Baumé acid. Pneumatic automatic control. Details in Catalog S-7460. National Carbon.

Blenders 61 — Heavy duty blenders feature rugged construction plus precision engineering for top performance and extra-long equipment life span. Details in Bulletin 354-A. J. H. Day.

Centrifuges 157 — Centrifuges feature the advantages of a deeper bowl . . . which leads to greater filtering area and increased production. Details contained in Booklet 5-RC-3. Heyl & Patterson.

Centrifuges 131 — Controlled concentration of solids from slurries is function which nozzle-type centrifuges perform with the highest efficiency. Details offered in Bulletin 1253. Sharples Corp.

Cleaning Systems, Vacuum 485I — Analyzes costly problem of industrial dust and describes complete line of vacuum cleaning equipment designed to combat it. Features and advantages. Bulletin A-939. U. S. Hoffman.

Collectors TR418 — Provide efficient removal of air-borne contamination (dust, fumes, vapors, acid gases & odors) & recovery of product thru multiple washing action. Bulletin 610. Claude B. Schneible.

Converters, Dry Ice L418 — Dry ice converters are A.S.M.E. code pressure vessels especially adapted to charging with full 50-lb. cakes of solid CO_2. Feature no operating costs. Dry Ice Converter Corp.

Crushers, Jaw R436a — Company line of jaw crushers features steel frames, anti-friction bearings, manganese steel liners. Size: 5" x 5" to 32" x 40". Offers technical bulletin. Denver Equipment Co.

Crushers, Jaw 485J — Illustrated, 24 p. offers complete data on line of jaw crushers. Built in 8 sizes with capacities up to 300 tons per hour. Details in Bulletin 1124. Traylor Engrg. & Mfg.

Crystallizers, Vacuum 29 — For producing none-caking, uniform crystals. Can be operated for long periods without shutdown time for cleaning. Principles and applications in Bulletin 50-A. Struthers Wells.

Dehumidifier-Filter 485K — Offers brochure, "Moisture Control in Compressed Air," which discusses types & quantities of impurities & methods for their removal. Advantages of VI-Speed method. Van Products.

Distillation 485L — Presents data on custom-engineered columns, exchangers, reboilers, auxiliaries & controls for use in distillation operations, in illustrated booklet. Colonial Iron Wks.

Dryers 135 — Designed to dry air to sub-zero dew points at low cost. Manual, semi-automatic or fully automatic tower reactivation. Simple & economical operation. Bulletin D-27. C. M. Kemp Mfg.

Dryers 305a — Drying air, other gases and organic liquids to precise, low conditions meet needs of industry and science. Covers description of function and operation. Pittsburgh Lectrodryer Corp.

Dryers TR427 — Products not critical to high temperatures dried more economically in flash or direct fired dryer. Details in complete catalog. Davenport Machine & Foundry Co.

Dryers 305b — Offers informative technical booklet, "The Moisture In Our Atmosphere," concerning the nature, behavior and measurement of water vapor. Pittsburgh Lectrodryer Corp.

Dust Collectors 485M — Collecting cast iron dust with Dustkop collectors illustrated & described. Covers problem, steps taken in selecting & installing equipment, etc. Bulletin 640 #1. Aget-Detroit.

Dust Collectors 60 — Fabric-type dust collectors offer many features including tension control to compensate for variation in fabric dimensions due to humidity changes. Bulletin 279. American Air Filter.

Dust Collectors 310 — Feature high efficiency, economical operation, dependable performance, economy of space required for installation. Applications in 18 industries. 28 p. American Wheelabrator.

Dust Collectors BR427 — Wet-type dust collectors feature high efficiency of collection, dependable performance, minimum of maintenance, low pressure drop, low cost. Bulletin 531. Dust Suppression & Engrg.

Dust Control 485N — Dust control in asbestos product manufacture. Shows how cloth-tube-type dust collectors are used to ventilate dust producing machines. Illustrated Bulletin 412. American Wheelabrator.

Dust Control R422 — Valuable information relating to scope of dust problem or collection equipment requirements found in new manual, "A Simplified Test Method for Dust Control Determination." Dustex Corp.

Dust Filters 377 — Feature constant custion at dust sources, self cleaning for continuous operation, no auxiliary motors or blowers, no abrasion of bags by cleaner, etc. Bulletin 102. W. W. Sly Mfg.

Dust Recovery 219a — New profits in terms of tons of valuable dust that can be returned to production rather than wasted in the air. Brochure explains 3 systems of industrial dust recovery. Buell Engrg.

Ejectors 485O — Ejectors feature no moving parts. They are efficient, quiet and simple to operate and maintain. Available in corrosion-resistant materials. Illustrated. Jet-Vac Corp.

Evaporators 55 — Vertical rapid concentration evaporators offer high rates of evaporation, maximum recovery of solids, with simple, easy operation. Data on drying, evaporation, processing. Buflovak.

Felts, Papermakers' 485P — Introduces a new series of technical bulletins which includes data on the use, operation, and maintenance of papermakers' felts. All material brought up-to-date. F. C. Huyck & Sons.

Filter Fabrics, High-Twist 485Q — Many features: scientifically engineered; highly efficient; low costs; field proved & accepted; wide range of fabrics & patterns. Data Sheet & Sample Card. Equipment Development.

Filter Plates BR403 — New filter plates for plate & frame presses. Offer many features: strong yet light; easy to handle, clean & maintain; etc. Details in Bulletin 541. Multi-Metal Wire Cloth.

Filters 485R — For difficult clarification problems. Applied where solutions carry fine particles in suspension (colloidal matter) or where solids are sticky or gummy in nature. Elmco Corp.

Filters, Oil 323 — Makes available 4 filter catalogs—Industrial, Aviation, Automotive and Fleet. Describes the many types of filters for various industries. Illustrated. Purolator Products.

Filters, Pressure Leaf 213 — For flow rates 2 to 5 times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Catalog NC-1-53. Niagara Filters Div.

Filters, Stainless Steel 485S — For free-flowing, light to heavy-bodied liquids. Data on tubular, pipe line and vertical floor-mounted filters. Includes photos and dimensional drawings. Bulletin 489. Cherry-Burrell.

Technical Literature, cont . . .

Filtration & Fluids-Handling BR418a	Data . . for user of filtration & fluids-handling equipment. Articles on "tricks of the trade" in filtration; washing & drying filter cake; filter aid do's & don'ts; etc. T. Shriver.
Grinding & Blending Systems 419	Integrated system features savings in time & money in combined functions of grinding, blending & dust control. Results in greatly increased production. Pulverizing Machy.
Kettles TL435	Corrosion-resistant kettles meet every processing need. Easy to clean & keep clean & available in sizes up to 500 gallon capacity. Technical Bulletin. Lee Metal Products.
Kettles, Electro-Vapor 84	Electro-vapor kettles put heat to work quickly, efficiently and with a minimum of loss. They are simple in operating principle and almost maintenance-free. Bulletin 2324. Blaw-Knox.
Kiln Room Furniture 486A	Illustrated, 16 p. contains data on kiln room furniture and supplies. Covers tile setters, sandless setter rings, firing racks, placing pins, etc. Catalog 54-C. Louthan Mfg. Co.
Kilns, Rotary 486B	Offers many years of experience in designing & building kilns, dryers & coolers for diverse industries including synthetic resins, sand & gravel, oil refining, etc. W. P. Heineken.
Laboratory Equipment 311a	Assures accurate samples. Helps cut sampling costs . . . improve product quality . . . increase sales. Offers features of full-sized production machines. Sturtevant Mill Co.
Mills 241a	Help solve grinding, crushing & separating problems. Offer a better product . . . faster production . . . lower costs. Detailed literature. Williams Patent Crusher & Pulverizer.
Mills, Ball R436c	Bulletin on steel head ball mills. Feature cast steel heads, cut tooth gears, protected trunnion bearings, manganese steel liners. Size: 30" x 18" to 6' x 24'. Denver Equipment Co.
Mills, Colloid TR438	Advanced features for uniform grind: improved ball bearings which center shaft & minimize lateral whip; invar shafting with zero coefficient of heat expansion. Admiral Tool & Die.
Mills, Grinding 486C	Pulva-Sizers feature dustless operation, ultra fine grinding, easy cleaning, durability, compactness, etc. Also contains data on Com-Bin feeders. Illustrated. Pulva Corp.
Mills, Grinding BM446	Dry, grind and classify—in a single system—materials carrying an appreciable amount of surface moisture, reducing them to dry, finely-ground products. Bulletin 17-B-11. Hardinge.
Mixers 211a	Catalogs cover laboratory mixers, portable mixers, top entering mixers, etc. Data on impeller selection, sizing, best type of vessel, installation & operation hints. Mixing Equipment.
Nozzles BL405	Company makes available catalog describing their Spraco Nozzle line. Includes information on full cone, flat spray, and hollow cone types. Spray Engineering Co.
Nozzles, Spray R435	Nozzles available for every spray job. Used for acid chambers, air washing, chemical processing, cooling ponds, desuperheating, gas scrubbing, etc. Catalogs 6A & 6C. Monarch Mfg. Works.
Pharmaceutical Equipment 486D	Describes company line of pharmaceutical equipment: single punch & rotary tableting presses; mixing, flaking, drying & granulating machines; etc. Bulletin 630. F. J. Stokes Mach.
Presses, Filter 486E	Industrial filter presses are efficient, low in initial cost, economical to operate. Includes specifications of construction in illustrated Bulletin 17. Brosites Products Corp.
Process Equipment TL409b	Information on reaction vessels, compressors, pumps, valves, fittings, tubing, instruments, dead-weight gages, pilot plants, etc. in detailed Catalog 406-A. Superpressure Div.
Processing Apparatus 2	32 p. describes various continuous processing systems. High rate of heat transfer affords advantages for heating, crystallizing, controlling heat of reaction, etc. Girdler Co.
Processing & Mining Equipment 486F	Equipment for mining, processing & construction industries. Covers underground rock loading equipment, vacuum filters, ball mills, air motors, etc. Illustrated. Eimco Corp.
Propellers BM422	Smooth, vibrationless propeller for stirring, mixing, aerating, pumping, etc. Balanced to avoid whip & strain on shafts. In wide variety of metals & sizes up to 60". Michigan Wheel.
Pulverizers, Laboratory Sample 486G	1 lb. of average Mesabi Range iron ore, previously crushed to 4 mesh or finer, is pulverized to 100 mesh in 2¼ minutes. Other features in Bulletin LP1-B. Denver Equipment.
Reactors, Three-Stage 486H	For softening or clarifying surface waters for process, industrial or municipal applications & for treatment of industrial waste water. Detailed Bulletin. American Water Softener.
Screens, Vibrating R436b	Vibrating screens feature two bearing drive, low horsepower, all steel construction. Size: 1' x 3', to 6' x 14'; 1, 2, 3 or 4 decks. Technical bulletin. Denver Equipment Co.
Scrubbers, Fume 217	Used to absorb fumes from such reactions as sulfide reductions, chlorosulfonic or oleum sulfonations. Types and characteristics offered in Bulletin 4-R. Schutte & Koerting.
Shredders, Swing Hammer 486I	56 p. contains detailed information on company line of swing hammer shredders and wood hogs. Includes 8 p. insert offering technical data. Illustrated Catalog 855. Jeffrey Mfg.
Solvent Recovery 486J	Photos & drawings show how solvent-laden air, filtered thru activated coconut shell carbon can result in pure, stripped air plus salvaging of reusable solvents. Barnebey-Cheney.
Strainers 486K	Protect expensive pipeline equipment against sediment. Longer-lasting special stainless steel mesh screen has larger free area. Offers Bulletin 252. V. D. Anderson Co.
Towers, Scrubbing, Hydraulic 66	Offer high collection efficiency, freedom from clogging or sticking, resistance to high heat, corrosion & abrasion, etc. Engineering Bulletin AP-525. Buffalo Forge Co.
Tubular Equipment 486L	Covers standard line of exchangers, evaporators, crystallizers & other tubular equipment for process applications. Includes charts, tables, photos, drawings, etc. Colonial Iron Wks.
Vessels, Pressure, Unfired 486M	Two new summaries of the A. S. M. E. Code for Unfired Pressure Vessels pin-point essential data. Available in separate, illustrated, 4 p. brochures. Alloy Fabricators.
Vessels, Pressure, Welded 137b	Tells most important factors to consider before buying any tanks, valves, etc. Gives blueprints & specifications. Data on manufacturing techniques. American Car & Foundry.

Pumps, Blowers, Compressors

Compressors 371	Built to individual specifications & range from single stage to 5 & 6 stages with pressures up to 25,000 lbs. Assure efficient, trouble-free operation. Detailed catalog. Norwalk.
Compressors 486N	Built for long life & constant performance. No internal wearing parts, no valves, pistons or vanes & no internal lubrication. Maintenance is low. Compact & save floor space. Nash Engrg.
Compressors 169	Small, compact compressors feature 15 to 125 hp; 81 to 641 cfm; pressures to 125 psi, standard. (high pressure units to 250 psi); force-feed lubrication; etc. Bulletin A-56. Joy Mfg.
Pumps 245a	Provides complete information on corrosion-resisting pumps for heavy-duty chemical service. Available in 12 standard Durco alloys. Durcopump Bulletin P/1. Duriron Co.
Pumps, Acid & Chemical 373	Metals and alloys used in acid and chemical pumps are carefully selected for ability to resist corrosive and abrasive action of liquid pumped. Bulletin 203-6. Lawrence Pumps.
Pumps, Boiler Feed 325	Used throughout industry for many services. Capacities range up to 2,000 gpm, pressures to 1,200 psig, temperatures to 350F. Data in Catalog 1502. De Laval Steam Turbine.
Pumps, Centrifugal TR403	Feature superior performance in pumping highly abrasive mixtures, corrosive liquids, hot solutions or heavy slurries. Provides detailed information in Catalog 5206. Nagle Pumps.
Pumps, Cenarifugal 170-1b	Impervious graphite pumps feature mechanical seal with enclosed coolant, rugged type SN armored connections, interchangeability of parts, etc. Catalog S-7250. National Carbon.
Pumps, Centrifugal 308a	Mechanical seal offers new development in pump design—eliminates leakage & assures trouble-free operation. Sizes, capacities and prices in detailed Bulletin. Bell & Gossett.
Pumps, Centrifugal 357	Offer high quality design & materials; maximum standardization & interchangeability of parts; heads up to 260 ft; capacities 200-6400 gpm; 19 sizes; etc. Bulletin 721.6. Goulds Pumps.
Pumps, Chemical 486O	Contains original approach to NPSH (net positive suction head), together with data on use of this concept in selecting turbine pumps for chemical service. Section 100. Roy E. Roth.
Pumps, Controlled Volume 34	Fill the growing industrial need for precision metering of liquids in the higher pressure ranges. Offers complete information in Bulletins 1153-A and 553. Milton Roy Co.
Pumps, High Pressure 486P	Information on Triplex high pressure pumps and Gaulin industrial homogenizers. Includes data on features, applications, specifications in illustrated Bulletin 1-53. Manton-Gaulin.

Pumps, Process 313 — In wide choice of materials . . . to handle many types of abrasive or corrosive material at temperatures up to 250 F. Feature no leakage Bulletin 08B6615. Allis-Chalmers.

Pumps, Proportioning TL409a — 3 pumps in one—7,500, 15,000 or 30,000 psi working pressure made possible by interchange of piston & cylinder assemblies in same pump frame. Bulletin 4061-A. Superpressure Div.

Pumps, Rotary BL436 — Feature fast, thorough stripping action. Efficient stripping is possible because of suction lift created by "gear-within-a-gear" pumping principle. Bulletin 54SC. Viking Pump Co.

Pumps, Sanitary TL436 — Positive displacement sanitary pumps for product protection. Feature longer life and more efficient performance at low maintenance cost. Offer Instruction Handbook. Waukesha Foundry.

Pumps, Slurry 370 — Slurry pumps handle extremely thick slurries with high specific gravities. Feature long operating life with little or no maintenance. Offer Bulletin 181. Morris Machine Works.

Pumps, Vacuum 107 — Information on company line of 13 single stage & compound vacuum pump models . . . the largest, most versatile pump line on the market. Bulletin V-51B. Kinney Mfg. Div.

Pumps, Vacuum 376 — Offer cost-saving advantages: reduced first & operating costs; low maintenance; small floor space . . . less expensive foundations; etc. Bulletin 50-B-13. Roots-Connersville.

Pumps, Vertical TL405 — Designed to handle molten sulphur. Steam jacketed discharge pipe keeps molten materials from solidifying. Operate efficienly at slow speed of 1750 rpm. Bulletin V-837. Taber Pump.

Purifiers 487A — Guaranteed to remove 99% of mist and dirt particles such as guck, sludge, oil, and scale from steam, vapor, gas and air lines. Data in Bulletin 501. V. D. Anderson Co.

Instruments and Controls

Actuators, Valve BR438 — For power operation of gate, plug diaphragm, and other line valves. They are pneumatically or hydraulically operated for direct or remote control. Bulletin 3000. Ledeen Mfg.

Analyzers, Gas 301 — Thermal conductivity gas analyzers feature L&N gas analysis cell assembly and advanced, electronic Speedomax recorder. Advantages in Folder ND46-91(2). Leeds & Northrup.

Cells, Pressure 487B — Offers information on a new transducer, the Dynaformer Pressure Cell. Includes circuit details and cell specifications in Technical Report TI 27-A-12a. Foxboro Co.

Controllers, Furnace & Oven 487C — Includes information on idicating pyrometers & controllers for permanent mounting or portable use, indicating thermometer controllers, etc. in Bulletin P1262. Bristol Co.

Controls, Thermal 82 — Help solve temperature control problems which involve heat, humidity, radiant heat, pressure and other variables. Offers complete information on Thermoswitch units. Fenwal.

Detectors, Metal, Electronic 355 — Help solve tramp metal problems. Sensitive to all metals . . . detect even minute particles and signal their presence. Complete data in Bulletin B-1920-A. Dings Electronics.

Dynamometer Systems 487D — For testing internal combustion engines, transmissions, torque converters, pumps, fans, compressors, etc. Covers features in Bulletin GEA-5923. General Electric.

Electronic Data Processing 487E — 30 p. illustrated booklet, "Light on the Future," describes the significant principles and components of electronic data processing equipment. International Business Machines.

Gages 404 — For pressure, vacuum or compound service. No gears or teeth to wear out. Cam wiping action keeps contact points clean & smooth. Details in Catalog G-2. Helicoid Gage Division.

Gages R446 — Reflex or transparent gages lined with natural & synthetic rubbers, lead, phenolic base compounds, teflon, etc. assure long-life & dependability. Drawing GD-431. Jerguson Gage.

Gages 30-1 — Superior performance of gages is the result of creative research, highly functional design, quality control of both materials & methods, etc. Catalog 300. Manning, Maxwell & Moore.

Gages, Liquid Level BL416 — Describes liquid level gages: reflex; thru vision; tubular. Standard equipment in leading refineries & industrial plants all over the world. Offer Catalog. Strahman Valves.

Gages, Liquid Level 39 — Offers illustrated guide to selecting the right liquid level gage sets at the most economical cost. Covers advantages, use, specifications, etc. Catalog 35. Penberthy Injector.

Gages, Tank BL435 — Information on 100% automatic tank gages for gaging liquids of all kinds. Gages are approved by the Underwriters' Laboratories. Offers complete details. Liquidometer Corp.

Gages, Vacuum, Molecular 65c — New vacuum gage has no detector tube to burn out or be damaged by inrush of air, if accidently opened to atmosphere. Details in Bulletin GEC-986. General Electric Co.

Hydrometers & Thermometers 487F — 36 p. catalog features nearly 1,000 models all made in accordance with requirements of the National Bureau of Standards, A.S.T.M., A.P.I., etc. Emil Greiner Co.

Indicators, Bin Level 487G — Simple, reliable & inexpensive means of indicating level of granular, pulverized and semi-liquid materials stored in tanks, silos, hoppers and bins. Bin-Dicator Co.

Instruments, Test, High Current 487H — Description, dimensions & illustrations of calibrating & testing instruments are included with a listing of indicated uses & industrial applications. Catalog MA-154. Multi-Amp.

Measurement, Steam 487I — Engineered equipment package makes possible the measurement of steam under widely different load conditions. Description & advantages in Application Memo K19. Builders-Providence.

Meters 89 — For continuous, accurate weighing of bulk material passing over conveyor belts. Respond accurately to rapid load variations. Details in Bulletin 550-H4A. Builders-Providence.

Meters, Flow TL428 — Feature simple design with only 3 moving parts —no breakdown due to complicated gears and mechanism. Indicate flow within 3% absolute accuracy, even with pulsating flow. Hennsey.

Oxygen Analysis Systems 487J — Outlines a recommended list of equipment to provide an accurate and dependable analysis system for industrial gas process streams. Bulletin # AD-610. Arnold O. Beckman.

Panels, Graphic 67 — Data available on graphic panels of outstanding efficiency and appearance, engineered and fabricated to desired specifications. Also Bulletin 471 on Consotrol Instrumentation. Foxboro.

Potentiometers 487K — Technical data on new diaphragm bellows-type differential pressure potentiometers. Includes photos, specifications, temperature vs. deviation graph etc. Data Sheet 508. Bourns Labs.

Pyrometer-Controllers 487L — Covers specifications & prices for indicating electronic pyrometer controllers, indicating mercury switch pyrometer controllers, etc. in detailed Bulletin P1260. Bristol Co.

Pyrometer-Controllers 65a — Reduce rejects & improve product quality. Maintain even furnace temperatures despite changes in voltage or ambient. Accurate to ¾ of 1% of full scale. Bulletin GEC-713. Gen. Elec.

Pyrometers, Hand 65b — Uses & applications for portable instruments which measure temperature of any surface, liquid, gas or molten metal from 0 to 1500F. Bulletin GEA-6020. General Electric Co.

Rectifiers, Mechanical 414 — Superior features result in practical immunity of rectifiers to arc-backs from all causes, low contact wear, low maintenance, low service costs. Offers data. Brown Boveri.

Regulators TR425 — Compact, self-contained regulators are effective, accurate, low-cost means to control the flow of light slurries and liquids. Provides complete details. W. A. Kates Co.

Regulators, Temperature 392 — Feature safe, dependable temperature control in industrial processes. Rugged controls are self-powered, self-contained, almost maintenance-free. Catalog GC-D. Fulton-Syiphon.

Sampling Systems, Dry Gas 487M — Illustrates and describes the operation of a sampling system for the dry gas samples encountered in many chemical applications, in Bulletin #702. Arnold O. Beckman.

Thermocouples, Wire Type 381 — One of many, standard thermocouples for taking process temperatures. Other kinds include tubular, bayonet immersion contact, exposed loop, etc. Offer Catalog 22E. Thermo Electric.

Thermometers 303 — Solve temperature checking problems and reduce thermometer costs. Feature multiple helix for better accuracy & all-metal construction for longer life. Weston Elecl. Instrument Corp.

Thermometers, Dial 487N — Details specifications & special features of various types of dial thermometers for industrial & laboratory use. Includes data on accessories. Rochester Manufacturing Co.

Transmitters, Differential 487O — Low-head type differential-pressure pneumatic transmitters designed particularly for measuring liquid fuels, & automatic control of fuel-air ratio. Builetin,2753. Hagan Corp.

Transmitters, Flow Signal 487P — Describes heavy-duty pneumatic signal transmitters for use in measuring, indicating & controlling fluid flow & liquid level. Details in illustrated Bulletin 2553. Hagan Corp.

Bulletins and Catalogs feature latest developments.

Technical Literature, cont . . .

Transmitters, Pneumatic 320	Presents full story on Republic transmitter flexibility. Describes line of transmitters, including square root extracting & pneumatic electric models. Republic Flow Meters.
Viscometers L458	Standard instruments for nearly every type of viscosity determination problem. Feature high accuracy & sensitivity. Details on all models & accessories. Brookfield Engrg. Labs.
Wires, Thermocouple 488A	Thermocouple & extension wires most often used for standard pyrometric work. Wires featured are those with plastic insulations, fiberglass insulations, etc. Bulletin 31. Thermo-Elec.

Construction Materials

Alloys, Cupro Nickel 488B	Data on corrosion-resisting characteristics of iron-modified 90:10 cupro nickel alloy in sea water. Includes 50 charts, tables & illustrations. Bulletin A-170. International Nickel.
Aluminum Products 254-5a	Makes available numerous technical handbooks. Each book is an authoritative reference on a single aspect of aluminum design or fabrication. Fully illustrated. Reynolds Metals.
Castings, High Alloy 364	Information on castings designed for heat resistance, corrosion resistance, abrasion resistance. All carefully tested in up-to-date laboratory. Bulletin 3150-G. Duraloy Co.
Coatings, Protective 488C	Data on neoprene sprayed coatings & sheet linings. Outlines protective qualities in applications affected by sunlight, heat, abrasion, oil, cold, chemicals, etc. Metalweld.
Coatings, Protective 147	Specially formulated from coal-tar pitch base. Stop corrosion caused by moisture—acid fumes—alkaline fumes—corrosive soil—salt air—heat. Offers set of booklets. Koppers Co.
Coatings, Protective 353	Stonelike acidproof coatings for floors, walls, tanks, trenches . . . provide superior protection for concrete surfaces. Includes details and specifications. Bulletin 110. Ceilcote.
Copper & Copper Alloys 488D	Illustrated, 47 p. contains technical data on copper & copper alloys. Covers quality & service, coppers, brasses, bronze alloys, nickel alloys, etc. Revere Copper & Brass.
Fabrication, Sheet & Plate 368	Complete fabricating & assembling facilities for any type, size & quantity of sheet & plate products & weldments thru ¾" thickness. Brochure of plant & products. Kirk & Blum.
Fabrication, Process Equipment 433	Facilities permit company to fabricate everything from glassed steel to alloys and clad materials. Heat-treating furnaces are among largest in use. Bulletin 902-AA-4. Pfaudler.
Fabrication, Process Equipment 369	Permanite corrosion-resistant equipment low in cost & economical in operation. Light weight offers speed & facility in handling, shipping, erecting. Illustrated. Maurice A. Knight.
Flooring, Steel Reinforced 488E	Designed for trucking aisles, loading docks and other similar areas subjected to materials handling equipment and severe abuse. Data on many features and advantages. United Labs.
Insulation, Cellular Glass 83a	Solve insulating problems with unique cellular glass insulation. It is moisture-proof, acidproof, fireproof & has a strong, rigid structure. Offers booklets. Pittsburgh Corning Corp.
Insulation, Pipe 488F	For insulation & protection of hot underground pipes. Includes numerous charts, tables, drawings, photos & graphs in new, 20 p. Technical Data Manual. American Gilsonite Co.
Insulation, Pipe 83b	Unlike the ordinary pipe insulations, Foamglas insulation stays dry, assuring constant life-long insulating performance and avoiding corrosion of piping. Pittsburgh Corning Corp.
Lead Products 129	For efficient control of corrosives. Provides all common mill shapes, sizes and forms . . . sheet, pipe, fittings, valves. New booklet on "Chemical Lead Products." National Lead Co.
Linings, Tank 398	Saran rubber's high degree of chemical and abrasive resistance makes it the ideal lining for sulfuric acid storage tanks. Offers details in Catalog. Saran Lined Pipe Co.
Metal Specialties B405	Complete service on metal specialties. Crates, trays, racks, etc.—designed & built for specific materials handling, heat treat & corrosion resistant end use. Cambridge Wire Cloth.
Paints 488G	Bulletin describes new patented dirt repelling paint, "Staize-Clene." Flat enamel odorless paint stays clean from 79 to 90 percent longer. Enterprise Paint Manufacturing.
Paints, Aluminum 349	Feature added protection, long life, greater hiding capacity, greater light reflectivity, etc. Ideas for usage in new Aluminum Painting Handbook. Metals Disintegrating.
Plastics 488H	Series of bulletins describes lines of casting resins, plastic foam, & other RF & microwave insulation materials. Covers physical & electrical properties. Emerson & Cuming.
Plastics, Thermosetting 488I	Clear, transparent, scratch & abrasion resistant sheet material, developed from thermosetting resins, offers high optical & mechanical properties. Illustrated Bulletin 1052. Homalite.
Platinum Cladding 300	Pure platinum—or a suitable precious metal alloy-bonded throughout to a base metal support. Corrosion resistance of platinum available at reasonable cost. Booklet 96. Baker & Co.
Refractories 488J	New, 16 p. illustrated tour book describes the only completely integrated processing facilities for the manufacture of basic refractories. Kaiser Aluminum & Chemical Corp.
Selectors, Stainless Steel 321	For fast, accurate selection of stainless steels. Data on physical or mechanical properties, resistance to corrosion or scaling machinability characteristics, etc Crucible Steel.
Steels, Stainless 17a	"Armco's ELC Stainless Steels" presents data on 2 extra-low carbon stainless steel grades that are fully satisfactory for service in welded equipment up to 800F. Armco Steel.
Steels, Stainless 488K	44 p. general catalog covers stainless steels, lists their applications, sizes & forms, & resistance to various corrosive media. Also includes data on properties. Armco Steel.
Steels, Stainless, Welding 17b	Offers copy of "How to Control Carbide Precipitation in Welding Stainless Steels"—the latest & one of the most concise articles ever written on the subject. Armco Steel.
Steels, Stainless 488L	36 p. includes descriptions indicating where stainless is used in pulp & paper industries plus data on the technology of Allegheny Metal. Illustrated. Allegheny Ludlum Steel.
Steels, Stainless 488M	Issue folder on stainless steel library of informative booklets which help the user select the right grade of stainless steel and fabricate it at low cost. Armco Steel.
Tantalum Equipment 363	Immunity to hydrochloric, nitric & perchloric acids, iodine, bromine, etc. eliminates shutdowns, repairs, lost production time, spoilage, & other costly corrosion results. Fansteel.

Pipe, Fittings, Valves

Fittings 143	Master Catalog describes the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic & silicone rubbers. Klinger Corp.
Fittings, Flare 242-3	Proven absolutely leakproof even under severest conditions of vibration, high pressures & temperatures. Available in wide range of shapes & sizes. Catalog 4300. Parker Appliance Co.
Fittings, Welding 265	Improve design and reduce costs. Exclusive Midwest manufacturing process produces fittings of superior metallurgical properties. Data in Catalog 54. Midwest Piping Co.
Hose, Air 488N	Extremely flexible wire braid air hose built for mucker use. Natural rubber cover treated for resistance to abrasion and impact. Will not sun check. Bulletin H4003. Elmco Corp.
Hose, Metal, Flexible 41a	Varied applications for flexible metal hose & tubing. Shows how tubing is designed, used & installed. Includes specifications on tubing & fittings. Booklet CC-400. American Brass.
Hose, Metal, Flexible 333a	For practically unlimited engineering uses—simplifies design, construction, operation & maintenance. Types of hose, fittings, etc. in 48 p. Metal Hose Catalog 200. Titeflex, Inc.
Joints, Ball 54a	Used where low cost, leakproof movable joints are needed in piping handling steam, air, oil, water, gas, or chemicals. Many models available. Catalog 215. Barco Mfg. Co.
Joints & Couplings 391c	Teflon expansion joints and flexible couplings absorb shock, vibration, thermal expansion and contraction. Connect unlike piping ends & nozzles. Bulletin FC-952. United States Gasket.
Joints, Expansion 68	Comprehensive, up-to-date information on the absorption of motion in piping gathered together in one easy-to-use booklet—the new Expansion Joint Design Guide. Flexonics.
Joints, Revolving 54c	Superior design insures trouble-free performance, minimum roll drag, and up to 50% power savings. Ratings to 250 psi (steam); 450°F. Details in Catalog 300. Barco Mfg. Co.

Joints, Rotary 488o — New ball-and-socket type rotary joints designed to permit transformer of liquid or steam into or out of any revolving drum. Covers operation and construction. Illustrated. Key Co.

Joints, Swing 54d — New line of ball bearing swing joints complete with sizes & styles to meet every requirement on loading racks, fueling assemblies & chemical applications. Catalog 400. Barco Mfg. Co.

Joints, Swivel 54b — Self-aligning joints provide flexibility in piping. Leakproof, safe—pressure or vacuum. Ratings as high as 600°F., 3000 psi (hydraulic). Catalog 265. Barco Mfg. Co.

Joints, Swivel 54c — Company produces a complete line of high pressure hydraulic swivel joints for use with small diameter tubing or pipe. Covers details in Catalog 269. Barco Mfg. Co.

Pipe & Fittings 170-1c — For superior corrosion resistance. Impervious graphite pipe and fittings readily installed, durable, easily maintained, resist corrosive fluids. Catalog S-7000. National Carbon Co.

Pipe & Fittings, Glass 79 — 20 p. illustrated catalog describes most practical means of fighting pipeline corrosion & contamination. Covers basic properties, performance, economy, etc. Corning Glass Wks.

Reseating Equipment, Globe Valve 489A — Designed to facilitate efficient & economical maintenance of globe valves. Offers data regarding construction & operation in Operating Manual & Parts List. 32 p. Leavitt Mach.

Tubes 489B — Explains use of Duplex tubes for heat exchangers & condensers in industries & process plants handling corrosive liquids, gases, refrigerants, etc. Bulletin 1954. Bridgeport Brass.

Tubing, Metallic, Flexible 318 — For air & gas lines, for transmission of oil, steam & liquids. Offers tough, rugged "seep-proof" construction. Illustrated Data Book. Pennsylvania Flexible Metallic Tubing.

Tubing, Stainless Steel 329 — For economical, trouble-free service over long periods of use. Offers price calculator for full price data & weight per foot of tubing size & grade you need. Trent Tube Co.

Unions, Stainless Steel 372 — Illustrated literature available on stainless steel unions designed and built for top performance on all metering, measuring and flow control services. Clayton Mark & Co.

Valves 345 — 300-pound heavy-duty all-iron valves feature safe control for ammonia and other hard-to-handle fluids. Offer information on product line in new 6 p. Folder AD1977. Crane Co.

Valves 245b — Easily operated, non-lubricated, maintenance-free valves reduce down time and costs. Built of corrosion-resisting alloys with a teflon sleeve. Durco Valve Bulletin V/4. Duriron.

Valves, Air Check 489C — Offer many advantages: replace stop & safety valves; do not leak; long-lived; cut costs; eliminate "air hammer" & "tank ring"; quiet; etc. Bulletin 509-D. Pennsylvania Pump.

Valves, Air Release 489D — These sturdy units vent air from water and gases from liquids. For 500 psi and pipe connections from ½" to 2½". Offers detailed information in Bulletin 844. V. D. Anderson Co.

Valves, Bronze 489E — Bronze valves offer superior design, construction & operating features. All popular sizes in stock for prompt delivery. Details in Circulars 534, 582, 574. Lunkenheimer Co.

Valves, Diaphragm Control 76 — Complete data on company line of diaphragm control valves in Valve Engineering Data Catalog, Bulletin CV53. Also Valve Size Slide Rule Calculator. Kieley & Mueller.

Valves, Diaphragm Motor 489F — Detailed information on high pressure diaphragm motor valves for wide band proportional control, offered in illustrated Specification Sheet 426. Minneapolis-Honeywell Regulator Co.

Valves, Gate, Bronze 90 — Success of 200 lb. line of union bonnet bronze gate valves results in expanding line to include 125 lb. & 150 lb. classes. Engineering features in Catalog Folder. Ohio Injector.

Valves, Jacketed 489G — Covers operational features of jacketed valves for heated-cooled gages or wherever small jacketed angle valves are required. Specifications. Data Units 220, 221. Jerguson Gage.

Valves, Lubricated Plug 40 — Plug valves offer new dependability with teflon gaskets. Gasket characteristics: can't bind; self lubricating; pressure tight; etc. Catalog No. 4. American Car & Foundry Co.

Valves, Plug 253a — Superior performance assured for steel dry plug valves and cast steel gate valves. Pertinent information on valves in Stockholm and Wedge-plug Catalogs. Wedgeplug Valve Co.

Valves, Porcelain 420 — Easy working & long life in chemical atmospheres . . . for porcelain valves. Complete description, characteristics & specifications in detailed Bulletin. Lapp Insulator Co.

Valves, Relief 489H — Piston-type oil relief valves regulate primary system pressure of oil burner systems. Covers description, specifications and dimensions in Bulletin R-313. Eclipse Fuel Engrg. Co.

Valves, Safety & Relief 489I — Stainless steel safety and relief valves feature superior design and performance. Offers pertinent data on liquid service and vapor service valves. Associated Valve & Engrg. Co.

Valves, Solenoid BL407 — Covers new line of cast iron & cast steel solenoid valves in sizes from ¼" to 2". Pressures range to 1000 psi at 200°F., 500 psi at 450°F. Bulletin 106. Atkomatic Valve.

Valves, Storage Tank 137a — Storage tank & tank car valves last longer, flow faster, maintain trouble-free service. Specifications of all types available for various ladings & uses. American Car & Foundry

Electrical Equipment

Drives, Speed 445b — Company offers literature which describes a complete line of adjustable speed drives for coordinating all kinds of production processes. Bulletin No. 11-1P1. Century Electric Co.

Generators 445c — Two bulletins available for AC and DC generators. AC generators—63 to 250 KVA (Bulletin 18-1P21). DC generators—.75 to 200 KW (Bulletin 18-1P1). Century Electric Co.

Lighting Equipment, Emergency 489J — Data on new line of auxiliary emergency lighting equipment. Includes schematics, layouts & illustrations of typical emergency lighting installations. Electric Storage Battery.

Motor Control, Synchronous . 59 — Includes data on these 3 pertinent features: graduated squirrel-cage protection; precision angle switching; load angle field removal. Bulletin GEA-5873. General Electric Co.

Motor Starter-Circuit Breakers 20-I — Explosion-proof dust and rain—tight circuit breaker and motor starter Unilets feature superior design, construction and performance. Details in Bulletin BH. Appleton Electric.

Motors 35-8a — Data on new Life-Line "A" motors. Covers new insulating materials, new stator core, new cooling methods, new precision manufacturing techniques. Booklet B-6154. Westinghouse.

Motors 16 — Designed & engineered for more efficient performance. Smaller in size, lighter in weight & quieter in operation. Covers many features in Motor Bulletin CE3304. Diehl Mfg.

Motors 489K — Information about new NEMA standards for electric motors. Offers comparative dimensions between old and new proposed Century NEMA frames 1 to 30 hp. Form 1676. Century Elec. Co.

Motors 283 — Diversified in design & can be readily adapted to a wide range of compressor, pump and blower applications. Includes information on complete line. Bulletin MU-185. Wagner Electric.

Motors 379 — Extra dependability of Electro Dynamic industrial motors shown in new report. Covers data on comparative tests conducted in accordance with A. I. E. E. standards. Electro Dynamic.

Motors Brake 87 — Designed for applications where rapid stopping of rotation is required. Brakes of standard construction for long life & trouble-free operation. Bulletin BR-1. Howell Elec.

Motors, Drip-Proof 45a — Open—drip-proof motors in NEMA rerate sizes offer: better protection against falling water & debris; long bearing life; quiet operation; etc. Bulletin 51B6210. Allis-Chalmers.

Motors, Explosion-Proof 45c — Valuable information on company line of explosion-proof motors. Feature superior performance in addition to reduced costs for maintenance. Bulletin 51B7286. Allis-Chalmers.

Motors, Gear 445d — Gear motors from ¼ to 15 rp, single, double and triple gear reduction. From ¼ to ¾ hp refers to Bulletin 4-5P21-61. From 1 to 15 hp refers to Bulletin 4-1P31. Century Electric.

Motors, Polyphase 445e — Squirrel cage induction—¼ to 400 hp, Bulletins 6-1P1, 6-1P3, etc.; wound rotor—1 to 400 hp. Bulletin 6-3P1; synchronous—20 to 150 hp, Bulletin 6-5P1. Century Electric.

Motors, Single Phase 445a — Split phase induction—⅛, ¼, ½ hp, Bulletin 1-5P1; capacitor—¼ to 20 hp, Bulletin 1-1P3; repulsion start, brush lifting, induction—½ to 7½ hp, Bulletin 2-1P1. Century Electric.

Motors, Totally-Enclosed 45b — For especially dirty, corrosive or hazardous applications, totally-enclosed, fan-cooled motors feature many cost-saving advantages. Details in Bulletin 51B7225. Allis-Chalmers.

Switches 32a — Performance & advantages described for various switches. Included are float switches, fluid level switches, flow switches and indicating switches. Revere Corporation of America.

Switches, Float, Fuel Tank 489L — Fuel tank float switches ideally suited for numerous industrial applications where fluid level control is important. Offers details in Bulletin 1200. Revere Corp. of America.

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Gaskets, Teflon-Jacketed 391a	Includes pertinent data on corrosion-resistant teflon-jacketed gaskets for glass-lined steel connections, Corning conical flanges, etc. Bulletin TG-953. United States Gasket.
Isolators, Shock & Vibration 490B	Designed to reduce shock & noise caused by impact-type machines, & vibration & noise caused by heavy rotating & reciprocating machines. Offers informative Bulletin 538. Barry Corp.
Packings, Valve & Pump 391b	V-rings, cup and cone, and wedge type packings of chemical resistant pure teflon—engineered for greater flexibility and resiliency—covered in Bulletin TP-1053. U. S. Gasket.
Reducers, Speed 15	Planetary gear design provides better alignment of pinions and gears, which in turn reduces noise and wear. Data on other features in detailed Catalog. Phila. Gear Works.
Rings, Quad 490C	Describes newly-patented quad ring, a 4-lipped rubber seal that resists spiral twist. Covers applications, engineering features & characteristics, etc. Minnesota Rubber & Gasket.
Rings, Teflon 361	Corrosively inert teflon rings effectively seal any hydraulic fluid, including newly developed synthetics, & resist high temperatures as well. Illustrated booklet. Crane Packing.
Seal Cages, Teflon 408	For lubricating or cooling stuffing box packing. Withstand contact with acids, organic solvents, thionyl chloride, etc.—at normal & elevated temperatures. Chem & Power Products.
Seals, Mechanical TL416	Information on the high-efficiency mechanical seal with the unique spring drive. Provides answer to all types of shaft sealing problems. Details in Bulletin 9. Sealol Corp.
Turbines, Steam 78	Turbines range from 150 hp down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Bulletin 135. Coppus Engrg.
Wrenches 378	Put speed on the job—far stronger & safer than open end or adjustable wrenches. Industrial & General Catalog of 4000 tools for production & maintenance. Snap-On Tools.

Heating & Cooling

Boilers, Automatic 490D	Feature two-pass design, guaranteed minimum efficiency of 80%, maximum radiant heat transfer from flame to water-cooled furnace walls, etc. Bulletin BE3. Boiler Engrg. & Supply.
Boilers, Packaged 69	Excellent results on factory and on-job tests assure greatest return from boiler investment. Available for oil, gas and combination oil/gas firing. Catalog AD-100. Cleaver-Brooks.
Combustion Control 490E	Full account of Morton Salt's "exposed" steam generator at Manistee, Mich., featuring air flow-steam flow compensated combustion control, in illustrated Bulletin R-10. Hays.
Coolers, Air-Quenching 490F	Describes how savings can be effected in cement, lime & chemical industries thru use of an air-quenching shaking grate cooler. Illustrated, 24 p. Bulletin 07B7869. Allis-Chalmers.
Coolers, Cascade 170-1d	For cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop, redwood waterguide strips. Catalog S-6820. National Carbon.
Drying Systems, Flash 346	New simplified process for reducing di-calcium phosphate to a fine dry dust-free product. Details on Raymond Cage Mill Flash Drying System. Catalog 54A. Raymond Div.
Exchangers, Film Type 168	Offer economy of first cost, operation & maintenance in power, petroleum & chemical industries. Serve as jacket water coolers, feed water heaters, etc. Bulletin HE-7. Henry Vogt Mach.
Generators, Steam 490G	Describes & illustrates complete line of steam generating equipment. Includes generous use of sectional views with concise descriptions. 16 p. Bulletin SB-50. Erie City Iron Wks.
Generators, Steam R416c	Economical & efficient, producing steam for process or heat. Fire-tube (20-600 b.h.p.), Catalog 622-F. Water-tube (200-1000 b.h.p.), Catalog 622-W. Superior Combustion.
Generators, Steam, Water Tube 490H	Shows production methods and materials employed in fabrication and assembly of Keystone steam generators within the company's plant. Illustrated Catalog SB-51. Erie City Iron Wks.
Heat Exchangers 308b	Company manufactures a comprehensive line of heat exchangers and centrifugal pumps for industrial applications. Provides catalogs for detailed information. Bell & Gossett.
Heat Exchangers 52	Describes brazed aluminum heat exchangers for difficult heat transfer applications requiring close temperature approaches, multi-stream exchange, or low temperatures. Trane Co.
Heat Exchangers 170-1j	Feature chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740. National Carbon.
Heat Exchangers 93	Help solve heat exchanger problems completely and efficiently. Offers information on shell and tube heat exchangers in descriptive Bulletin HT-654. National Radiator Co.
Heat Exchangers 388a	Superior operating performance and efficiency at lower initial and maintenance costs. Covers service on heat transfer equipment. Bulletin 600-2. Industrial Filter & Pump Mfg.
Heat Exchangers Tube Bundle 170-1a	New standardized heat exchanger design features lower first cost, more area per unit, choice of tube lengths, faster delivery, etc. Details in Catalog S-6840. National Carbon.
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Platecoils 334	For tank heating & cooling problems due to inefficient pipe coils. Cost-saving Platecoils heat or cool 50% faster & take 50% less space in the tank. Bulletin P61. Tranter Mfg.
Traps, Drainage 229a	Data offered on high capacity drainage traps for fast, trouble-free condensate drainage. Feature large capacity, fast air venting, low maintenance. Armstrong Machine Works.
Traps, Float 490J	Data on three styles—Junior Trap for draining air and steam lines, separators, storage tanks; Model D for 250 psi; Model F for low pressures. Bulletin 950. V. D. Anderson.
Traps, Steam 424	Steam traps provide numerous advantages; more production; low initial cost and maintenance; easy installation; stainless steel construction; etc. Bulletin T-1740. Yarnall-Waring.
Traps, Steam 490K	Vent air from steam units 8 times faster than ordinary inverted bucket traps. Covers advantages, specifications & capacities, etc. in illustrated Bulletin 1153. V. D. Anderson.
Traps, Steam 229b	44 p. illustrated Steam Trap Book describes company line and includes 14 p. of data on how to size traps for nearly every type of equipment. Armstrong Machine Works.
Tubes, Condenser 215a	Data on copper alloys, photos of condenser tube corrosion, photomicrographs of grain structure of different metals under varying operating conditions. Revere Copper & Brass.
Tubes, Heat Exchanger 490L	Latest report on performance of aluminum heat exchanger tubes. Among applications shown are zoned radiant heating exchangers in new Alcoa Building. Aluminum Company of America.
Vaporizers, Dowtherm 490M	Designed & constructed on LaMont principle of forced recirculation for high temperature heat transfer. Units operate safely & continuously at 750°F. International Boiler Wks.

Handling & Packaging

Bag Closing Machines 490N	Emphasizing importance of speed & economy in closing small paper bags, brochure describes & illustrates equipment designed for these operations. Bulletin 100. Union Special Mach.
Belting, Elevator 490O	24 p. illustrated engineering handbook covers types of belt bucket elevators, factors for belt selection, procedures for engineering the correct belt, etc. B. F. Goodrich Co.

Belts, Conveyor 491A	Hot material conveyor belts with rayon fabric reinforcement are thinner, dissipate heat more quickly, offer greater ply adhesion than cotton fabric belts. B. F. Goodrich.
Carriers, Pivoted Bucket 491B	Help solve tough materials handling problems. Many circuit layouts possible—handle fragile crystals, lump or powdered materials. Pivoted Bucket Bulletin CE-454. Hapman Conveyors.
Cement Slurries 50-11	Offers reprints of new article, "Facts for the Cement Industry on Flow of Slurries," which discusses all key factors involved in flow of cement slurries. Monsanto Chem. Co.
Clamps, Fork Truck 491C	Dual-purpose clamping attachments designed to mechanize storing, loading and unloading operations with extraordinary ease and speed. Offers illustrated Folder. Lewis-Shepard.
Conveyors, Belt 491D	Company makes available an 80 p. "Redi-Fab" conveyor erection manual which features hundreds of illustrations showing every phase of erection and operation. Barber-Greene Co.
Conveyors, Belt, Sectional 46-7a	Consist of completely assembled factory-stocked components that can be quickly & economically installed & maintained by your own personnel. Bulletin 132-B. Hewitt-Robins.
Drums, Acid 289	Both inside and outside, two-piece acid drums are designed to protect shipments of corrosive and poisonous chemicals. Offer Hackney Drum and Barrel Catalog. Pressed Steel Tank.
Feeders, Vibration 491E	Feature higher output, easier control, lower power needs, smaller space needs, safer operation, less vibration, etc. Complete details in Data Sheet 5302. Richardson Scale.
Gluers & Sealers 431	Greatly increase number of cases that can be prepared for shipment within a given period. Wide choice of models to meet exact requirements. Descriptive catalogs. Standard-Knapp.
Hoists, Electric 491F	Includes performance & safety features, cutaway drawings showing details of construction, specifications & dimensions of all 17 models from 500 to 4000-lb. capacities. Coffing Hoist.
Loaders 491G	1½ yard loaders offer sure-footed 4-wheel drive traction & patented "bucket rocking action" plus other built in exclusive features. Illustrated Bulletin. Le Roi Co.
Materials Handling 491H	New, 28 p. illustrated reference, "The Turner System of Materials Handling," offers valuable ideas for savings in labor, space and equipment. Factory Service Co.
Materials Handling 491I	Shows how new & revolutionary units are used to work-position, dump, store, collect & transfer variety of materials & scrap. Details in illustrated Booklet MH-811. Union Metal Mfg.
Materials Handling, Bulk 479	Tote System speeds up weighing and blending operations, automatically, accurately; reduces labor and handling costs; eliminates product loss; etc. Illustrated. Tote System.
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Ramps, Loading 491J	Data on complete line of hydraulic adjustable loading ramps. Includes design & construction features, engineering diagrams & application data in illustrated brochure. Rowe Methods.
Scales, Automatic Filling 491K	Describes automatic net weight and gross weight filling scales especially built for production weighing of granular, flake, pellet or fibrous materials. Thayer Scale & Engrg.
Tank Car Classifications 137c	Reference tells at a glance which tank car to use for any given lading. Also blueprints and latest ICC regulations as they relate to tank usage. American Car & Foundry.
Tank Cars, Welded 137d	Illustrated booklet includes pictures and specifications of standard types for gasoline, liquid caustic soda, sulphuric acid and many other products. American Car & Foundry.
Tractors 491L	36 p. fully illustrated catalog presents data on complete line of industrial equipment. Includes tractors, motor graders, motor wagons, motor scrapers, etc. Allis-Chalmers.
Tractors 491M	Illustrated booklet, "Your Job, Your Equipment and Caterpillar Service," depicts service facilities of Caterpillar dealers across the country. Form D410. Caterpillar Tractor.
Tractor-Shovels 275	Faster, heavier, with more horsepower than any tractor-shovels of comparable capacity. Also feature economy and durability. Offers illustrated Fact-Folio. Clark Equipment Co.
Tractor-Shovels 84	Improve output & simplify material-handling problems. Job Studies available—illustrating & describing operations in several different plants. Frank G. Hough Co.
Trucks, Fork 491N	Battery powered trucks offer compactness, high capacity-to-weight ratio, full free lift, dependable performance, low maintenance. Proof Folders & Comparison Charts. Lewis-Shepard.
Trucks, Fork 491O	Offers illustrated, 16 p. bulletin depicting advantages of palletized handling. Includes specifications and dimensional drawings on the eight Palletier models. Barrett-Cravens.
Trucks, Fork Lift 491P	Reveals findings of survey at plant of Hudson Motor Car Co. Shows vital role played by fork lift trucks in feeding materials to assembly line. Illustrated Job Study 129. Towmotor.
Trucks, 2-Wheel & Platform 491Q	32 p. with structural details, specifications & complete data on over 50 models, including two-wheel hand trucks, steel-framed platform trucks, wagon trucks, etc. Catalog T-54. Fairbanks.
Unloaders, Car BR456	Makes available literature showing how one man is able to move three tons of material in sixty seconds with a B-G car unloader. Illustrated Folder. Barber-Greene.
Vibrators 491R	Announces a complete line of quiet, powerful electric vibrators to move, settle and package stubborn materials. Information in illustrated Catalog 10. Cleveland Vibrator Co.

Safety Equipment

Alarms, Smoke 491S	For coal, oil, gas burning installations. Offer many features: instant warning of illegal smoke; remote bell; low cost & easy installation; etc. Bulletin 110. Standard Instrument.
Apparel, Safety BL422	Offers new 1954 catalog describing benefits of acid and caustic resistant industrial apparel of Du Pont Orlon and Union Carbide's Dynel in illustrated, 16 p. Worklon, Inc.
Clothing, Protective 491T	Fact Sheet describes four superior features of heavy duty work gloves: wing thumb; reinforcing welt; continuous palm; heavyweight leather. Illustrated. American Optical.
Face Guards 491U	For frontal & side face protection against flying objects, abrasive particles, chemical splash. Offer comfort, balance, resistance to weather. Bulletin 0302. Mine Safety Appliances.
Fire Protection, Foam 281	Illustrated booklet with data on the advantages of foam. Tested on petroleum or polar-solvents fires. Checked as to extinguishment time, foam volume, sealability. National Foam System.
Fire Protection Systems 491V	Valuable information on economical, efficient, automatic fire protection systems which safeguard property, prevent loss of life, etc. Illustrated Bulletin 2426. Blaw-Knox.
Gas Masks 491W	Describes canister-type gas masks. Includes data on canister construction, canister life, methods of determining gas concentrations, etc. Bulletin 541. Acme Protection Equipment Co.
Selectors, Industrial Glove 491X	Instantly shows correct glove for every industrial need by rating the gloves according to their resistance to various kinds of destructive elements. Surety Rubber Co.

Processes & Services

Ammonia Synthesis 141	Advantages of Texaco partial oxidation process, Foster Wheeler improved liquid nitrogen wash system, & Casale ammonia synthesis process, in Bulletin 0-54-1. Foster-Wheeler.
Ground Water Development 251	Offers service on any immediate phase of ground water development—maintenance or modernization of existing equipment—new pump equipment—drilling etc. Layne & Bowler, Inc.
Low Temperature Processing 217	36 p. brochure on low-temperature processing of gases, liquids, and solids. Describes the broad opportunities—illustrates present and probable applications. Air Products, Inc.
Plant Location 475	Data on raw materials, transportation, power and fuel, markets, labor, sites, community services, laws and regulations. Physical map included. N. Y. State Dept. of Commerce.
Processing, Combination 491Y	Savings thru integration of number of different refining steps into single, continuous, centrally-controlled operation without intermediate storage. Illustrated. M. W. Kellogg.
Production Equipment, Heavy 306	"Facilities and Products" includes data and photos which show why company can turn out —at low cost—specialized heavy equipment for chemical plants. Newport News Shipbuilding.
Water & Pollution Control 491Z	"Water Supply and Pollution Control" includes data on distribution of water, water requirements, stream pollution, procedures for pollution control, etc. Mellon Institute.

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16	50–1c	69	96–7f	143	166	227b	265	282E	301	322c	355	388d	BL407	429	455	484Y	486N	489B	491J
17a	50–1d	71–2	96–7g	145	167	227c	267	283	302	322d	356	388e	R407	431	BR456	484Z	486O	489C	491K
17b	50–1e	73	96–7h	146	168	229a	268–9	284A	303	322e	357	390	408	432	L458	484AA	486P	489D	491L
18	50–1f	74	98	147	169	229b	270A	284B	304	322f	358	391a	TL409a	433	459	485A	487A	489E	491M
20–1	50–1g	75	100a	148A	170–1a	231a	271	284C	305a	323	359	391b	TL409b	434	TL473	485B	487B	489F	491N
24	50–1h	76	100b	149	170–1b	231b	272A	284D	305b	324	360	391c	BL409	TL435	BL473	485C	487C	489G	491O
25	50–1i	77	101	150A	170–1c	232–3a	272B	284E	306	325	361	391d	410	BL435	R473	485D	487D	489H	491P
26a	52	78	102	150B	170–1d	232–3b	273	284F	307	326	362	392	411–2	R435	475	485E	487E	489I	491Q
26b	53	79	103	152A	170–1e	232–3c	274A	284G	308a	327	363	393	413	TL436	476	485F	487F	489J	491R
26c	54a	80–1a	104	152B	170–1f	235	274C	285	308b	329	364	394	414	BL436	477	485G	487G	489K	491S
26d	54b	90–1b	107	152C	170–1g	237	274D	286A	309a	330	365	395	TL416	R436a	478	485H	487H	489L	491T
26e	54c	80–1c	108	153	170–1h	239	274E	286B	309b	331	366	M396	BL416	R436b	479	485I	487I	490A	491U
27	54D	80–1d	109	154A	170–1i	241a	275	286C	310	332	367	L396	R416a	R436c	484A	485J	487J	490B	491V
29	54e	80–1e	111a	155	170–1j	241b	276A	286D	311a	333a	368	397	R416b	L438	484B	485K	487K	490C	491W
30–1	55	82	111b	156A	172	242–3	276B	286E	311b	333b	369	398	R416c	TR438	484C	485L	487L	490D	491X
32a	56a	83a	111c	156B	173a	245a	276C	286F	311c	333c	370	399	417	BR438	484D	485M	487M	490E	491Y
32b	56b	83b	111d	156C	173b	245b	276D	287	311d	333d	371	400	L418	439	484E	485N	487N	490F	491Z
32c	56c	84	111e	156D	174	247	276E	288A	311e	333e	372	401	TR418	TL440	484F	485O	487O	490G	495
32d	56d	85	113	157	211a	249	276F	288B	312a	333f	373	402	BR418a	R440	484G	485P	487P	490H	496
32e	56e	86a	117	158A	211b	251	277	288C	312b	333g	374	L403a	BR418b	441	484H				

. . . And these items in the Reader Service "Flashback" Section (p. 492)

138A	144A	146D	148D	148H	278A	280C	280G	282C	282F	284C	284F	286A	286D	288A	290C	292A	292D	292G	294C
142A	146A	148A	148E	148I	278B	280D	282A	282D	284A	284D	284G	286B	286E	290A	290D	292B	292E	294A	294D
142B	146B	148B	148F	148J	280A	280E	282B	282E	284B	284E	284H	286C	286F	290B	290E	292C	292F	294B	294E
142C	146C	148C	148G	276A	280B	280F													

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1 2 3 4 15 17 21 22 25 26 27 28 29 33 34 35 36 37 38 39 40 41 42 43 44 45 46

Send more information about these items in this issue as circled below: **(Card expires July 1)**

2	33	56f	86b	119	158B	211e	253a	278A	288D	312e	334	375	L403b	419	444	484I	485Q	488A	490I
6–7a	34	56g	87	121a	158C	211d	253b	278B	288E	312d	335	376	L403e	420	445a	484J	485R	488B	490J
6–7b	35–8a	56h	88a	121b	158D	211e	253c	278C	288F	312e	336	377	L403d	TL422	445b	484K	485S	488C	490K
6–7c	35–8b	57	88b	123	159	211f	254–5a	278D	288G	312f	337	378	L403e	BL422	445c	484L	486A	488D	490L
6–7d	39	58	88c	125	160A	211g	254–5b	278E	289	312g	338	379	L403f	BM422	445d	484M	486B	488E	490M
9	40	59	89	127	160B	213	254–5c	278F	291a	313	339	380	L403g	R422	445e	484N	486C	488F	490N
10	41a	60	90	129	160C	215a	254–5d	279	291b	314	344	381	L403h	424	445f	484O	486D	488G	490O
11a	41b	61	91	131	160D	215b	254–5e	280A	291c	315	345	382	L403i	L425	L446	484P	486E	488H	491A
11b	44	62–3	92	133	160E	217	254–5f	280B	292–3a	316	346	383	TR403	TR425	TM446	484Q	486F	488I	491B
11d	45	64	93	135	160F	219a	254–5g	280C	292–3b	317	348	384	BR403	BR425	BM446	484R	486G	488J	491C
12	46–7a	65a	95	137a	160G	219b	264–5h	280D	294–5	318	349	385	404	L427	R446	484S	486H	488K	491D
13a	46–7b	65b	96–7a	137b	160H	219c	254–5i	281	296–7	319	350	386	TL405	TR427	447	484T	486I	488L	491E
13b	48	65c	96–7b	137c	161	221	254–5j	282A	298	320	351	387	BL405	BR427	449	484U	486J	488M	491F
13c	49	66	96–7c	137d	162–3	222–3	257	282B	299a	321	352	388a	R405	TL428	450	484V	486K	488N	491G
14	50–1a	67	96–7d	139	164	225	261	282C	299b	322a	353	388b	TL406	BL428	451	484W	486L	488O	491H
15	50–1b	68	96–7e	141	165	227a	263	282D	300	322b	354	388c	TL407	R428	452	484X	486M	489A	491I
16	50–1c	69	96–7f	143	166	227b	265	282E	301	322c	355	388d	BL407	429	455	484Y	486N	489B	491J
17a	50–1d	71–2	96–7g	145	167	227c	267	283	302	322d	356	388e	R407	431	BR456	484Z	486O	489C	491K
17b	50–1e	73	96–7h	146	168	229a	268–9	284A	303	322e	357	390	408	432	L458	484AA	486P	489D	491L
18	50–1f	74	98	147	169	229b	270A	284B	304	322f	358	391a	TL409a	433	459	485A	487A	489E	491M
20–1	50–1g	75	100a	148A	170–1a	231a	271	284C	305a	323	359	391b	TL409b	434	TL473	485B	487B	489F	491N
24	50–1h	76	100b	149	170–1b	231b	272A	284D	305b	324	360	391c	BL409	TL435	BL473	485C	487C	489G	491O
25	50–1i	77	101	150A	170–1c	232–3a	272B	284E	306	325	361	391d	410	BL435	R473	485D	487D	489H	491P
26a	52	78	102	150B	170–1d	232–3b	273	284F	307	326	362	392	411–2	R435	475	485E	487E	489I	491Q
26b	53	79	103	152A	170–1e	232–3c	274A	284G	308a	327	363	393	413	TL436	476	485F	487F	489J	491R
26c	54a	80–1a	104	152B	170–1f	235	274C	285	308b	329	364	394	414	BL436	477	485G	487G	489K	491S
26d	54b	90–1b	107	152C	170–1g	237	274D	286A	309a	330	365	395	TL416	R436a	478	485H	487H	489L	491T
26e	54c	80–1c	108	153	170–1h	239	274E	286B	309b	331	366	M396	BL416	R436b	479	485I	487I	490A	491U
27	54D	80–1d	109	154A	170–1i	241a	275	286C	310	332	367	L396	R416a	R436c	484A	485J	487J	490B	491V
29	54e	80–1e	111a	155	170–1j	241b	276A	286D	311a	333a	368	397	R416b	L438	484B	485K	487K	490C	491W
30–1	55	82	111b	156A	172	242–3	276B	286E	311b	333b	369	398	R416c	TR438	484C	485L	487L	490D	491X
32a	56a	83a	111c	156B	173a	245a	276C	286F	311c	333c	370	399	417	BR438	484D	485M	487M	490E	491Y
32b	56b	83b	111d	156C	173b	245b	276D	287	311d	333d	371	400	L418	439	484E	485N	487N	490F	491Z
32c	56c	84	111e	156D	174	247	276E	288A	311e	333e	372	401	TR418	TL440	484F	485O	487O	490G	495
32d	56d	85	113	157	211a	249	276F	288B	312a	333f	373	402	BR418a	R440	484G	485P	487P	490H	496
32e	56e	86a	117	158A	211b	251	277	288C	312b	333g	374	L403a	BR418b	441	484H				

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138A	144A	146D	148D	148H	278A	280C	280G	282C	282F	284C	284F	286A	286D	288A	290C	292A	292D	292G	294C
142A	146A	148A	148E	148I	278B	280D	282A	282D	284A	284D	284G	286B	286E	290A	290D	292B	292E	294A	294D
142B	146B	148B	148F	148J	280A	280E	282B	282E	284B	284E	284H	286C	286F	290B	290E	292C	292F	294B	294E
142C	146C	148C	148G	276A	280B	280F													

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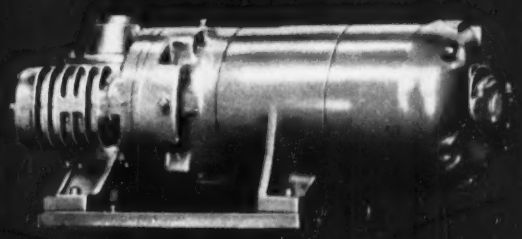

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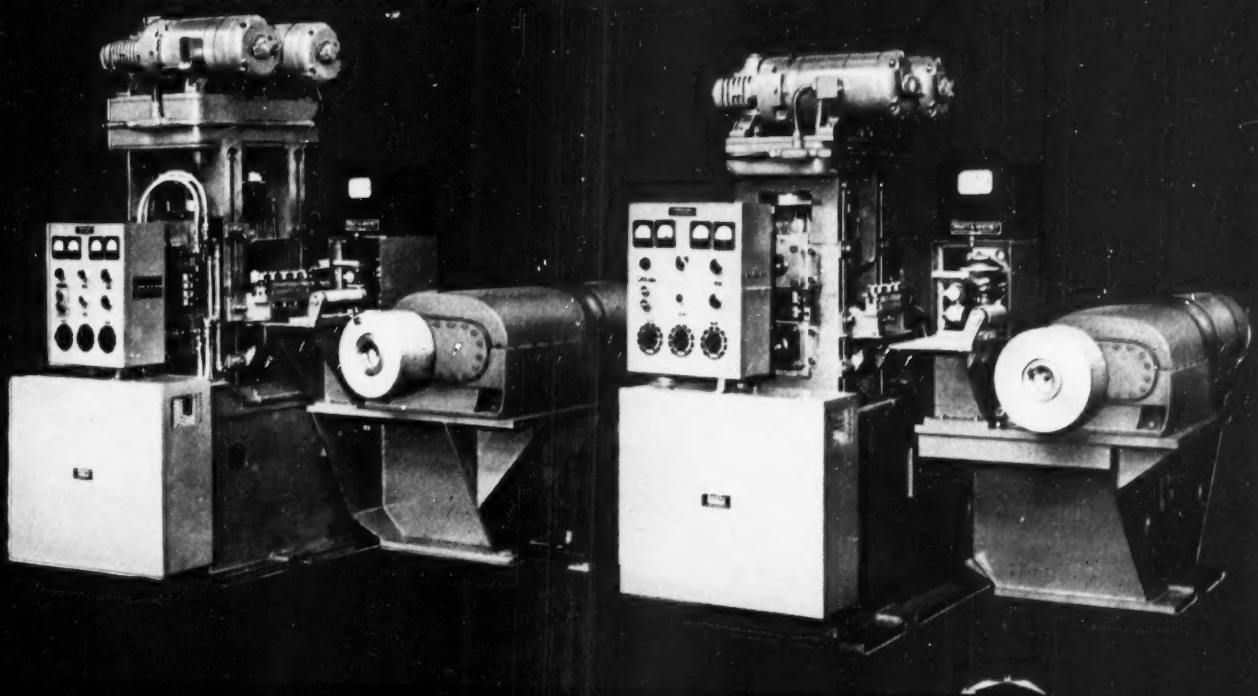

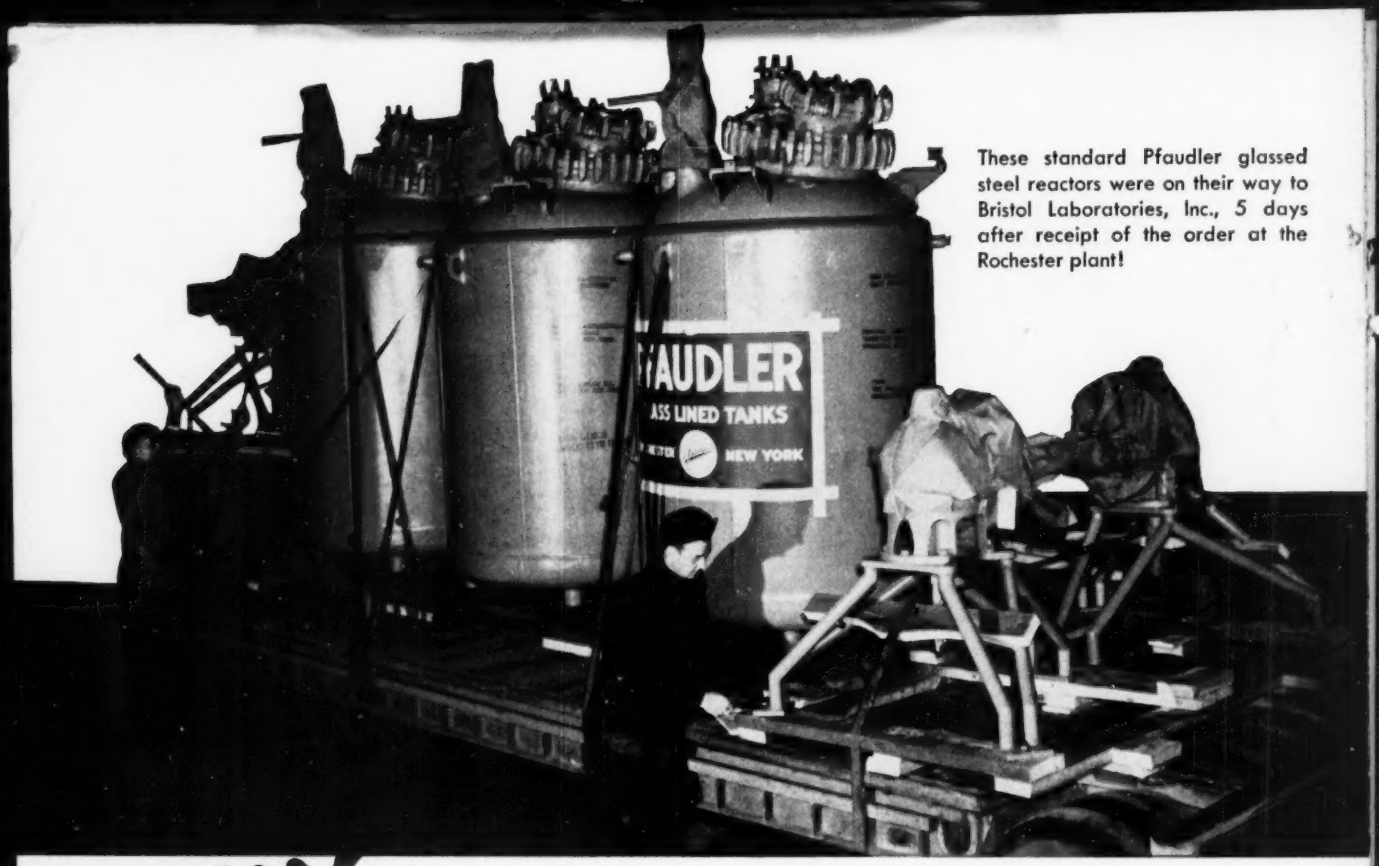

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13	14					
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